ARGO beleške / ARGO Notes

ARGO — Grupa za automatsko rezonovanje/Automated Reasoning Group
Matematički fakultet/Faculty of Mathematics

Univerzitet u Beogradu/University of Belgrade
Studentski trg 16
11000 Belgrade
Srbija

http://argo.matf.bg.ac.rs

Sadržaj

Šta su Argo beleške?

Predrag Janičić

13.11.2008.

Argo beleške bi trebalo da opisuju nove, nerazrađene istraživačke ideje, kao i aktivnosti Argo grupe i njenih članova (organizovane konferencije, seminari, učešće na konferencijama, posete drugim grupama itd.). Beleše nisu nužno strogo formalne (kao radovi za časopis, na primer). Beleške se pišu na srpskom ili engleskom jeziku. Beleške nisu zvaničan materijal i ne mogu se citirati u zvaničnim naučnim radovima. Po ideji i formi, Argo beleške slede seriju Blue Book Notes, Grupe za matematičko rezonovanje Univerziteta u Edinburgu.

The Argo notes should describe new, unpolished research ideas, as well as activities of the group members (organized conferences, seminars, participation in the conferences, visits to other groups, etc.). The notes are not necessarily formal (as journal articles, for instane). The notes are written in Serbian, or in English language. The notes are not official material and cannot be cited in official research papers. In the idea and the form, the Argo notes follow the series Blue Book Notes of the Group for Mathematical Reasoning, University of Edinburgh.

Kratki istorijat grupe ARGO

Predrag Janičić

10.10.2008.

Argo grupa ima svoje rane korene u Radionici za veštačku inteligenciju. Ta radionica bila je jedna od nekoliko koje su akademske godine 1994/95 pokrenuli tadašnji asistetni Matematičkog fakulteta — Goran Nenadić, Nebojša Vasiljević, Vlado Filipović i Predrag Janičić. Radom Radionice za veštačku inteligenciju rukovodio je Predrag Janičić, a u njenom radu učestvovali su Stevan Kordić (tada poslediplomac na Matematičkom fakultetu), studenti Petar Bukvić, Zoran Popović, Vladimir Filipović, Snežana Plamenac, ... i povremeno pojedini učenici Matematičke gimnazije, studenti Elektrotehničkog fakulteta, kao i Centra za multidisciplinarne studije.[1] Učesnici radionice sastajali su se obično jednom nedeljno, a najčešće teme predavanja bile su osnove automatskog dokazivanja teorema i računarsko igranje intelektualnih igara. Radionica je radila akademskih godina 1994/95 i 1995/96.

U periodu od 1997. do 1999. Predrag Janičić i nekoliko studenata — Nenad Dedić, Goran Terzić, Milica Labus, Aleksandra Krunić, Ivan Trajković, Ivan Elčić radili su zajedno na problemima u domenu automatskog rezonovanja, pre svega u domenu geometrijskog rezonovanja i u domenu fazne promene u problemu SAT. Neki od rezultata su predstavljani na smotrama radova studenata Matematičkog fakulteta, a neki objavljeni i u naučnim časopisima. Iako često nije bilo redovnih sastanaka i seminara, ove aktivnosti davale su obrise radionice za veštačku inteligenciju i matematički softver.

Od akademske godine 2004/05, poslediplomci Matematičkog fakulteta Filip Marić, Andrija Tomović i Dejan Jovanović radili su sa Predragom Janičićem (tada docentom) na problemima SMT, primenama tehnika istraživanja podataka u automatskom rezonovanju i primenama SAT rešavača u kriptoanalizi. Iz ovih aktivnosti proizašle su dve magistarske teze i nekoliko radova u vodećim časopisima i na vodećim konferencijama. Od 2005. godine ove aktivnosti se smatraju aktivnostima grupe za automatsko rezonovanje i Argo grupa dobija svoju prvu Internet stranu. Ime Argo, tada skovano, predstavlja igru reči: s jedne strane Argo je skraćenica od *Automated Reasoning GrOup*, a s druge ime broda (iz Grčkog mita) kojim su argonauti plovili u potrazi za zlatnim runom. Mit kaže da je brod Argo bio brz i lagan (toliko lagan da je posada mogla da ga nosi na ramenima), a Argo grupa ima za cilj razvoj malih, laganih i efikasnih sistema za automatsko rezonovanje. Konačno, legenda kaže da su na svom putu Argounati prošli tačku gde se spajaju Sava i Dunav, dakle — današnji Beograd.

Od akademske 2007/08, grupa Argo ima ima svoj redovan (dvonedeljni seminar). Te godine grupi su se pridružili i poslediplomci Matematičkog fakulteta Vesna Pavlović, Mladen Nikolić i Sana Stojanović. U tromesečnoj poseti ARGO grupi tokom 2008. bio je prof. Pedro Quaresma (University of

[1] Spisak svih učesnika, nažalost, nije sačuvan.

Coimbra, Portugal), a predavanja na ARGO seminaru su, pored posldiplomaca sa Matematičkog fakulteta, držali i posldiplomci sa Elektrotehničkog fakulteta, dr Claudio Castellini (University of Genova) i prof. Steven Quarrie (Ministarstvo za nauku Republike Srbije). Grupa Argo je u januaru/februaru 2008. organizovala četvorodnevni *Workshop on Formal Theorem Proving and its Application* sa oko dvadeset i pet učesnika iz pet zemalja.

Predrag Janičić je rukovodilac projekta ON144030 Ministarstva nauke Republike Srbije ,,Automatsko rezonovanje i napredne obrade velikih količina podataka i teksta“ (za period od 2006. do 2010), čiji su učesnici i svi članovi grupe Argo.

ARGO seminar 2007/2008

Vesna Pavlović

10.10.2008.

Argo seminar je seminar Argo grupe. Bavi se uglavnom, ali ne isključivo, automatskim rezonovanjem i primenama, teorijskim računarstvom, veštačkom inteligencijom i data-mining-om. Seminar je posvećen uglavnom studentima poslediplomcima. U principu, prvi deo seminara je tutorijalski, u drugom se izlažu istraživački problemi.

Sastanci se održavaju jednom u dve nedelje, uglavnom sredom u 17h u prostorijama Matematičkog fakulteta u Jagićevoj ulici.

Argo seminar se održava od akademske godine 2007/08.

Rukovodilac seminara je Predrag Janičić, a sekretar seminara Vesna Pavlović.

1 Održana predavanja

17.10.2007.

- **Filip Marić** (Matematički fakultet, Univerzitet u Beogradu)
  Tutorijal: SAT rešavači

  Apstrakt:
  SAT rešavači su programi koji ispituju zadovoljivost iskaznih formula. Formule se obično zadaju u konjunktivnoj normalnoj formi (CNF) i njihova zadovoljivost se ispituje modifikovanom verzijom DPLL (Davis-Putnam-Logemann-Loveland) procedure. Današnji SAT rešavači su u stanju da ispitaju zadovoljivost formula koje imaju nekoliko desetina pa čak i stotina hiljada varijabli i milione klauza. U okviru ovog predavanja će biti prikazan pregled vodećih SAT rešavača i biće dat prikaz nerekurzivne implementacije DPLL agoritma upravo na način na koji se koristi prilikom implementacije vodećih rešavača. Takodje, biće pomenute i neke modifikacije osnovnog DPLL algoritma koje su doprinele ogromnom uspehu današnjih SAT rešavača (nonchronological backtracking (backjumping), clause learning).

- **Mladen Nikolić** (Matematički fakultet, Univerzitet u Beogradu)
  Nove metode za računanje sličnosti čvorova grafova i sličnosti celih grafova

  Apstrakt:
  Postoji veći broj metoda za procenu sličnosti grafova. Jedan od

pristupa se bazira na proceni sličnosti njihovih čvorova. Metoda rasparenih sličnosti je nova metoda za računanje sličnosti čvorova koja na odredjenim problemima pokazuje bolje ponašanje od dosadašnjih, ali se može primeniti i na problemima na koje su dosadašnje metode bile neprimenljive. Najvažnija prednost je mogućnost konstrukcije mere sličnosti celih grafova na osnovu procenjenih sličnosti njihovih čvorova. Prva testiranja daju vrlo ohrabrujuće rezultate.

31.10.2007.

- **Mladen Nikolić** (Matematički fakultet, Univerzitet u Beogradu)
  Tutorijal: Mašinsko učenje

  Apstrakt:
  Mašinsko učenje je disciplina koja se bavi proučavanjem generalizacije i konstrukcijom i analizom algoritama koji generalizuju. Učenje se često može videti kao aproksimiranje ciljne funkcije (onoga što treba naučiti) ili kao pretraga prostora hipoteza vodjena podacima. Izbor prostora hipoteza je ključan za uspešno učenje, a kvalitet tog izbora se može proceniti pomoću Vapnik-Červonenkisove (VC) dimenzije ovog prostora. VC dimenzija opisuje prilagodljivost hipoteza podacima. Visoka VC dimenzija prostora hipoteza dovodi do poznatog problema overfitting-a. Način da se ovaj problem izbegne, odnosno da se postigne kvalitetna generalizacija je predložen u statističkoj teoriji učenja kroz princip strukturalne minimizacije rizika.

- **Filip Marić** (Matematički fakultet, Univerzitet u Beogradu)
  SMT rešavači i ArgoLib - kratak osvrt

  Apstrakt:
  U okviru ovog kratkog predavanja biće prikazani problemi koji se rešavaju korišćenjem SMT (Satisfiability Modulo Theory) resavača. SMT se bavi ispitivanjem zadovoljivosti formula odredjenih teorija prvog reda za koje postoje specijalizovane procedure odlučivanja. Najčešće korišćene teorije su linearna aritmetika (LA), teorija jednakosti sa neinterpretiranim funkcijskim simbolima (EUF), teorija nizova (ARRAYS), itd. Savremeni SMT rešavači su uglavnom zasnovani na DPLL(T) algoritmu koji predstavlja nadogradnju DPLL procedure na kojoj se zasnivaju savremeni SAT rešavači. SMT danas nalazi svoje primene u formalnoj verifikaciji softvera i hardvera, izgradnji kompilatora, optimizaciji i mnogim drugim oblastima računarstva.

- **Saša Misailović** (Elektrotehnički fakultet, Univerzitet u Beogradu)
  Automatizovano generisanje test ulaza korišćenjem imperativnih predikata

Apstrakt:
Korat je program za generisanje strukturno kompleksnih test ulaza. Iscrpno se generišu svi test ulazi do neke odredjene veličine. Osobine test ulaza korisnik piše u Javi u obliku imperativnog predikata. Pored toga, korisnik ograničava prostor stanja, kroz navodjenje mogućih vrednosti za polja strukture. Na osnovu ovako pripremljene strukture, Korat vrši pretragu prostora stanja i efikasno generiše sve neizomorfne strukture sa željenim osobinama. Više informacija o Koratu se može naći na adresi:
http://korat.sourceforge.net .

14.11.2007.

- **Filip Marić** (Matematički fakultet, Univerzitet u Beogradu)
  Tutorijal: Formalizacija iskazne logike u okviru sistema Isabelle

  Apstrakt:
  U okviru ovog predavanja će biti prikazane osnovne mogućnosti sistema Isabelle. Sistem Isabelle je jedan od najkorišćenijih alata za formalizaciju matematike koji omogućuje da se matematički pojmovi izraze u odgovarajućem formalnom okviru (najčešće u logici višeg reda) i da se nakon toga formalno dokažu teoreme koje opisuju njihova svojstva. Korišćenje sistema Isabelle će biti prikazano kroz formalizaciju iskaznog računa. Na početku će biti definisani pojmovi promenljive, literala, formule, valuacije, relacija zadovoljivosti, a nakon toga će biti dokazane mnoge teoreme koje važe za iskaznu logiku.

- **Claudio Castellini** (LIRA-Lab, University of Genova, Italy)
  Machine Learning for Hand Prosthetics (and more)

  Apstrakt:
  Currently, the dexterity of active hand prosthetics is hindered due to limitations in interfaces. How is an amputee supposed to command the prosthesis what to do (i.e., how to grasp an object) and with what force (i.e., holding a hammer or grasping an egg)? In this talk I address the issue by applying machine learning to the problem of regression from surface forearm EMG to the force a subject is applying. A detailed comparative analysis among three different machine learning approaches reveals that the apporach, as a whole, is viable. More applications of machine learning to grasping and reaching will be shown, among which prediction of grasping postures and of the user's intention to grasp.

5.12.2007.

- **Milan Banković** (Matematički fakultet, Univerzitet u Beogradu)
  Tutorijal: Analiza algoritama - praktičan pristup

Apstrakt:
Prilikom analize algoritama u praksi, veoma je važno proceniti očekivano vreme izvršavanja algoritma, odnosno proučiti ponašanje algoritma u prosečnom slučaju. Analiza prosečnog slučaja je, po pravilu, znatno složenija od analize najgoreg slučaja, i zbog toga je potrebno razviti moćniji matematički aparat. U okviru ovog predavanja biće ilustrovana primena funkcija generatrisa u analizi algoritama, pre svega kroz primenu u teoriji prebrojavanja, na kojoj se analiza prosečnog slučaja i temelji. Upoznaćemo se sa simboličkim metodom, kao jednim veoma intuitivnim šablonom za povezivanje skupova kombinatornih objekata sa funkcijama generatrisama koje te skupove prebrojavaju. Takodje će biti razmotrena i primena funkcija generatrisa u rešavanju rekurentnih relacija.

- **Vesna Pavlović** (Matematički fakultet, Univerzitet u Beogradu)
  Fazna promena u k-GD-SAT problemu

  Apstrakt:
  k-GD-SAT problem označava familiju slučajnih SAT problema koji se zasnivaju na geometrijskoj raspodeli dužina klauza sa parametrom p ($0 < p \leq 1$); za $p = 1$ dobija se tačno k-SAT model. Friedgut je napravio veliki proboj dokazom postojanja neuniformnog praga zadovoljivosti, tj. niza $r(n)$ oko koga verovatnoća zadovoljivosti formule ide od 1 do 0. Naš cilj je da dokažemo istu stvar za k-GD-SAT problem - tj. da k-GD-SAT ima oštar prag za svaku vrednost parametra p, i da na taj način (obzirom da je k-SAT problem samo jedna potklasa k-GD-SAT problema za $p = 1$) proširimo klasu SAT problema za koje ovo tvrdjenje važi.

26.12.2007.

- **Vesna Pavlović** (Matematički fakultet, Univerzitet u Beogradu)
  Tutorijal: Teorija tipova

  Apstrakt:
  Konstruktivna terija tipova s jedne strane predstavlja okvir koji spaja logiku i programske jezike na jedan elegantan način; na taj način razvoj programa i njegova verifikacija mogu da se izvršavaju kao jedinstven sistem. S druge strane, teoriju tipova možemo videti kao funkcionalni programski jezik sa nekim novim svojstvima. Pri odredjenim pretpostavkama moguće je definisati sistem koji je ujedno i logički sistem i programski jezik i u kome su tvrdjenja i tipovi ekvivalentni, kao i dokazi tvrdjenja, odnosno elementi tipova.
  U okviru ovog predavanja razmatraćemo osnove konstruktivističke logike, netipiziranog i tipiziranog lambda računa, a zatim ćemo videti na kojim je pravilima zasnovana teorija tipova, upoznaćemo se sa osnovnim pojmovima i tvrdjenjima teorije tipova, zaključno sa

Curry Howard izomorfizmom.

- **Milena Vujošević-Janičić** (Matematički fakultet, Univerzitet u Beogradu)
  Automatsko otkrivanje prekoračenja bafera u programskom jeziku C

  Apstrakt:
  Prekoračenje bafera je važan problem za kvalitet i bezbednost softvera. Tehnike za automatsko detektovanje prekoračenja bafera dele se na dinamičke i statičke tehnike. Dinamičke tehnike analiziraju program u fazi izvršavanja dok statičke tehnike analiziraju izvorni kod i imaju za cilj otkrivanje mogućih prekoračenja bafera pre nego što se program pusti u rad. U okviru ovog predavanja biće prikazan nov statički sistem za automatsko otkrivanje prekoračenja bafera. Sistem uzima u obzir kontrolu toka podataka i analizira i statički i dinamički alocirane bafere. Arhitektura sistema je fleksibilna i modularna. Na primer, sistem koristi spoljašnju biblioteku uslova koja je lako proširiva, a koja čuva pravila rezonovanja tako da ona nisu direktno kodirana u okviru sistema. Takodje, za proveru važenja generisanih uslova ispravnosti i neispravnosti komandi, može da se koristi bilo koji spoljašnji automatski dokazivač teorema koji prati SMT-LIB standarde. U okviru ovog predavanja, biće prikazana i prototip implementacija sistema - alat FADO.

16.01.2008.

- **Goran Predović** (Microsoft Development Center Serbia)
  Tutorijal: Algebarsko dokazivanje geometrijskih teorema (ADGT)

  Apstrakt:
  Iako je jasna veza izmedju geometrije i algebre utvrdjena još u 17. veku (Rene Dekart), teorija dokazivanja geometrijskih teorema koje su formulisane na algebarski način je razvijena tek krajem 20. veka kada je uspešne rezultate objavio kineski matematičar Vu Ven Cen (Wen-Tsun Wu). Algebarski dokazivači su se pokazali veoma moćni dokazujući na stotine netrivijalnih teorema i otkrivajući nove teoreme u geometriji. U okviru predavanja će biti predstavljene osnove ADGT-a, dve najpoznatije metode - Vuova metoda i metoda Grebnerovih baza, kao i integracija dokazivača u sistem GCLC sa primerima dokazanih teorema.

- **Filip Marić** (Matematički fakultet, Univerzitet u Beogradu)
  Izrada rasporeda časova korišćenjem iskaznog rezonovanja

  Apstrakt:
  U ovom predavanju će biti predstavljena tehnika izrade rasporeda časova tehnikom svodjenja na iskazno rezonovanje. Uslovi koji opisuju uslove korektnosti rasporeda časova (npr. da jedna nastavna grupa ne može istovremeno da ima dva predmeta, da jedan predavač

ne može istovremeno da predaje dva različita predmeta) kao i uslovi koji opisuju pojedinačne želje predavača (odredjeni predavači žele da rade samo odredjen broj radnih dana, imaju termine u kojima ne žele da rade, ne žele da imaju pauze u toku radnog dana) se opisuju iskaznom formulom i SAT solveru se prepušta pronalaženje modela formule. Svaki pronadjeni model predstavlja zadovoljavajući raspored časova.

29.01.2008. - 01.02.2008.

Workshop on Formal Theorem Proving

- Filip Marić (The Faculty of Mathematics, University of Belgrade):
  "Formal Verification of SAT Solvers"
- Predrag Janičić
  (The Faculty of Mathematics, University of Belgrade):
  "ARGO Group Presentation"

12.03.2008.

- **Bojan Marinković** (Matematički institut SANU)
  Tutorijal: Uvod u analizu algoritama

  Apstrakt:
  Ovim predavanjem biće prikazan pregled knjige "An Introduction to the Analysis of Algorithms" R. Sedgewick-a i P. Flajolet-a, u okviru ispitnog rada za kurs "Teorijsko računarstvo" na prvoj godini poslediplomskih studija na Matematičkom fakultetu Univerziteta u Beogradu.

- **Petar Maksimović** (Matematički institut SANU)
  Jednostavna karakterizacija potpunih jednočlanih skupova logičkih veznika

  Apstrakt:
  Za skup logičkih veznika kažemo da je potpun ukoliko se sve iskazne formule mogu izraziti koristeći samo veznike iz tog skupa. Na ovom predavanju će biti predstavljeni potrebni i dovoljni uslovi za potpunost jednočlanog skupa logičkih veznika. Ovi uslovi daju jednostavnu i elegantnu karakterizaciju, i, dodatno, omogućavaju obrojavanje potpunih jednočlanih skupova logičkih veznika proizvoljne arnosti.

02.04.2008.

- **Jelena Tomašević** (Matematički fakultet, Univerzitet u Beogradu)
  Tutorijal: XML baze podataka

Apstrakt:
U poslednjih nekoliko godina Extensible Markup Language (XML) je postao dominantni standard za opisivanje i razmenu podataka na Internetu. Sa druge strane, XML je uveo nekoliko novih problema kao na primer kako efikasno čuvati i upravljati XML podacima. U zavisnosti od stepena regularnosti strukture, XML dokumenti upadaju u dve široke kategorije: data-centric i document-centric. Data-centric dokumenti se karakterišu regularnom strukturom bez mešovitog sadržaja. Moguće je izvršiti preslikavanje ovakvih XML dokumenta u relacionu bazu podataka. Takve baze podataka nazvane su XML-proširene. Document-centric XML dokumenti se karakterišu neregularnom strukturom i mešanim sadržajem. Najbolji način za skladištenje i manipulisanje ovim dokumentima je u okviru izvornih XML baza podataka. Osnovne karakteristike izvornih XML baza podataka su:

- XML dokument je osnovna logička jedinica, kao što je to vrsta u tabeli kod relacionih baza.
- Minimalno, model mora uključiti elemente, atribute, tekstualne podatke (PCDATA) i redosled dokumenta.

Nema zahteva za postojanjem bilo kakvog specifičnog fizičkog modela skladištenja. Izvorne XML baze podataka smeštaju XML dokumente kao logičke jedinice i dobijaju podatke iz baze korišćenjem nekog od upitnih jezika kao što su XPath ili XQuery.

- **Vladan Radivojević** (poslediplomac na Matematičkom fakultetu, Univerzitet u Beogradu)
Mali deduktivni sistemi

Apstrakt:
Teorija L ima jedno pravilo izvodjenja i tri aksiomatske sheme (nad veznicima implikacija i negacija). Nad istim skupom veznika i sa istim pravilom izvodjenja postoje i manji deduktivni sistemi ekvivalentni teoriji L. Na primer, Mereditov sistem konstruisan 1953. godine sadrži samo jednu aksiomu. Nad Šeferovim veznikom se, takodje, može konstruisati deduktivni sistem sa jednom aksiomom ekvivalentan teoriji L. Jedan takav sistem je dao Nikod 1917. godine.
Rad se bavi ovim, "malim" deduktivnim sistemima kao i još nekim osobinama formula nad Šeferovim veznikom. Takodje, rad sadrži i kratak sažetak knjige S.Volframa "New kind of science".

19.04.2008. - 25.04.2008.

Spring School Geometry and Visualization

- Predrag Janičić
(The Faculty of Mathematics, University of Belgrade):
"Intelligent Geometrical Software"

- Vesna Pavlović, Sana Stojanović
  (The Faculty of Mathematics, University of Belgrade):
  "Formalization and Automation of Euclidean Geometry"
- Predrag Janičić
  (The Faculty of Mathematics, University of Belgrade):
  "GCLC - lab session"

16.04.2008.

- **Prof. Steve A. Quarrie** (Direktor Konsultativne kancelarije za medjunarodne projekte, Ministarstvo nauke, Srbija)
  FP7 and looking for the truth: you mathematicians have it easy!

  Apstrakt:
  What is the relevance of FP7 to young researchers and PhD students? FP7 has a lot of opportunities for young scientists to improve their research skills, but the best FP7 money goes to only the very best quality research. The talk will focus on how you ensure that you are doing the best quality research. Developing effective research skills needs constant help and support to understand what to do and, more importantly, why. The purpose of the post-graduate education is to teach PhD students how to THINK and to become RELIABLE as independent workers using RESEARCH as the vehicle for these goals. Research is looking for the TRUTH and a key to finding the truth is good experimental design. Examples will be presented of how to design experiments to enable you to find the truth and to recognise when you have found it. You will learn something about cheese, ozone, wheat and Canadian burglars!

14.05.2008.

- **Prof. Pedro Quaresma** (Univerzitet Coimbra, Portugal)
  Cryptology - a (very) Brief Survey

  Apstrakt:
  Cryptology is the the science of the enciphering and deciphering of messages in a secret code or cipher, the cryptography, and also the science (and art) of recovering information from ciphers without knowledge of the key, the cryptoanalysis. A brief presentation of this dual process of hidden/cracking the information, from the classical ciphers, to the modern symmetric, and public key ciphers will be presented.

04.06.2008.

- **Mladen Nikolić** (Matematički fakultet, Univerzitet u Beogradu)
  Metodologija izbora pogodnih vrednosti parametara SAT rešavača

Apstrakt:
Razni aspekti funkcionisanja SAT rešavača se definišu pomoću odredjenih parametara. Efikasnost SAT rešavača u velikoj meri zavisi od konkretne iskazne formule koja se rešava i od konkretnih vrednosti parametara rešavača. Stoga postoji potreba da se formuliše metodologija izbora vrednosti parametara koja bi polazila od analize svojstava formule koja se rešava. Formulisani pristup se bazira na predstavljanju formule u vidu grafa i korišćenju mera sličnosti nad grafovima kako bi se za nepoznatu formulu našli parametri za koje se SAT rešavač dobro ponaša pri rešavanju sličnih formula.

- **Vesna Pavlović, Sana Stojanović** (Matematički fakultet, Univerzitet u Beogradu)
Formalizacija i automatizacija euklidske geometrije

Apstrakt:
Ideja formalizacije geometrijskog rezonovanja je novijeg datuma i još je u svojim počecima, te predstavlja oblast za koju se očekuje da će biti u centru pažnje narednih godina. Više autora uspelo je da formalizuje deo Hilbertovih aksioma, takodje i deo aksioma Tarskog, i da uspe da formalizuje neke od teorema koje se odnose na te grupe aksioma. Dokazi teorema su izvedeni "ručno" uz pomoć sistema tipa Isabelle. Predmet našeg istraživanja je automatizacija ovog procesa, čime dobijamo i formalnu verifikaciju dokaza u sistemu Isabelle.

18.06.2008.

- **Panel diskusija** ()
Aktuelne istraživačke teme

Apstrakt:
Diskusija o iistraživačkim problemima kojima smo se bavili tokom prethodne akademske godine, kojima se trenutno bavimo i kojima planiramo da se bavimo.

ARGO seminar 2007/2008

Vesna Pavlović

10.10.2008.

Argo seminar is a regular seminar of the Argo group. Main fields discussed are Automated Reasoning and Applications, Theoretical Computer Science, Artificial Intelligence and Data Mining. The seminar is dedicated mainly to PhD students in Computer Science. One meeting typically consists of two lectures: a tutorial one (where known results on one specific topic are presented) and a research one (where original research work is presented).

Meetings take place once in two weeks, usually on Wednesday at 5:15PM, in the premises of the Faculty of Mathematics in Jagićeva street.

Argo seminar has started in academic year 2007/08.

The seminar's leader is Predrag Janičić, and a seminar's secretary is Vesna Pavlović.

1 Given talks

17.10.2007.

- **Filip Marić** (The Faculty of Mathematics, University of Belgrade)
  Tutorial: SAT solvers

  Abstract:
  Propositional satisfiability problem (SAT) is the problem of deciding if there is a truth assignment under which a given propositional formula (in conjunctive normal form) evaluates to true. It is a canonical NP-complete problem and it holds a central position in the field of computational complexity. SAT problem is also important in many practical applications such as electronic design automation, software and hardware verification, artificial intelligence, and operational reesearch. Thanks to recent advances in propositional solving technology, SAT solvers are becoming the tool for atacking more and more practical problems. This lecture will introduce the basic algoritms and data structures used in modern SAT solvers.

- **Mladen Nikolić** (The Faculty of Mathematics, University of Belgrade)
  New Measures of Similarity of Graph Nodes and Whole Graphs

  Abstract:
  A number of methods for computing graph similarity, already exists. One approach is to estimate similarity of graph nodes. Method of

Decoupled Similarities is a new method for calculating similarity of graph nodes. On some problems, this method exhibits advantages over already existing ones, but it can also be used to solve problems that existing methods can not solve. It's most important advantage is that it enables construction of measure of similarity of whole graphs based on calculated similarities of their nodes. First results are very encouraging.

31.10.2007.

- **Mladen Nikolić** (The Faculty of Mathematics, University of Belgrade)
  Tutorial: Machine Learning

  Abstract:
  Machine learning is a field concerned with study of generalization and construction and analysis of algorithms that can generalize. Machine learning can often be seen as an approximation of goal function (function that is to be learned) or as a data driven search of hypotheses space. Choice of hypotheses space is crucial for successive learning, and quality of that choice can be estimated based on Vapnik-Chervonenkis (VC) dimension of that space. VC dimension describes adaptability of hypotheses to data. High VC dimension of hypotheses space leads to well known problem of overfitting. A way to solve this problem and to achieve good generalization is outlined by statistical learning theory through structural risk minimization principle.

- **Filip Marić** (The Faculty of Mathematics, University of Belgrade)
  SMT solvers and ArgoLib

  Abstract:
  Satisfiability Modulo Theories (SMT) problem is a decision problem for logical formulas with respect to combinations of background theories expressed in classical first-order logic with equality. Examples of theories typically used in computer science are the theory of real numbers, the theory of integers, and the theories of various data structures such as lists, arrays, bit vectors and so on. This lecture will give a brief introduction to SMT problem and the SMT solver ArgoLib.

- **Saša Misailović** (School of Electrical Engineering, University of Belgrade)
  Automated test-input generation using imperative predicates

  Abstract:
  Korat is tool for constraint-based generation of structurally complex test inputs. Korat performs bounded-exhaustive generation - it generates all structures up to the given bound on their size.

Properties of desired test inputs are specified as imperative predicate, in the form of Java code. User also bounds the size of state space through finitization, which specifies possible values for the fields of the structure. Korat performs search of bounded state space and efficiently generates all non-isomorphic structures with desired properties. More informations about Korat can be found at: http://korat.sourceforge.net .

14.11.2007.

- **Filip Marić** (The Faculty of Mathematics, University of Belgrade)
  Formalization of propositional logic within the system Isabelle

  Abstract:
  This lecture will introduce the basics of proof assistant Isabelle. The Isabelle/HOL system one of the most widely used tools for formal theorem proving, developed at University of Cambridge (Larry Paulson) and TU Munich (Tobias Nipkow). System allows mathematical formulas to be expressed in a formal language and provides tools for proving those formulas in a logical calculus.

  This lecture will show the use of Isabelle through using the propositional logic as an example. The notions of propositional variables, literals, formulas and valuations, and the satisfiability relation will be defined and some of their basic properties will be formally proved.

- **Claudio Castellini** (LIRA-Lab, University of Genova, Italy)
  Machine Learning for Hand Prosthetics (and more)

  Abstract:
  Currently, the dexterity of active hand prosthetics is hindered due to limitations in interfaces. How is an amputee supposed to command the prosthesis what to do (i.e., how to grasp an object) and with what force (i.e., holding a hammer or grasping an egg)? In this talk I address the issue by applying machine learning to the problem of regression from surface forearm EMG to the force a subject is applying. A detailed comparative analysis among three different machine learning approaches reveals that the apporach, as a whole, is viable. More applications of machine learning to grasping and reaching will be shown, among which prediction of grasping postures and of the user's intention to grasp.

5.12.2007.

- **Milan Banković** (The Faculty of Mathematics, University of Belgrade)
  Tutorial: Analysis of Algorithms - practical approach

Abstract:
When algorithms are analysed in practice, it is very important to estimate expected execution time and examine the algorithm's average behavior. The average case analysis is, in most cases, more complexed, compared to the worst case analysis, and more advanced mathematical tools must be developed. In this talk we will illustrate generating functions and their application to analysis of algorithms. Generating functions are usually related to enumeration theory and combinatorics, which is the essence of the average case analysis. We will introduce the symbolic method, an intuitive method that binds sets of combinatorial objects to generating functions that enumerates them. Application of generating functions to solving of recurrence relations will also be considered.

- **Vesna Pavlović** (The Faculty of Mathematics, University of Belgrade)
Phase transition in k-GD-SAT problem

Abstract:
k-GD-SAT problem denotes the class of random SAT problems with geometrical distribution of clause length with parameter p ($0 < p \leq 1$); for the value $p = 1$ it becomes the k-SAT model. Friedgut made a huge breakthrough with a proof of existence of nonuniform satisfiability threshold, i.e. array $r(n)$ around which probability of satisfiability of a formula goes from one to zero.
Our goal is to prove the same thing for the k-GD-SAT problem - i.e. that k-GD-SAT has a sharp threshold for every value of parameter p and thus (keeping in mind that k-SAT problem is a subclass of the k-GD-SAT problem for the value $p = 1$) to extend the class of SAT problems for which this statement holds.

26.12.2007.

- **Vesna Pavlović** (The Faculty of Mathematics, University of Belgrade)
Tutorial: Type Theory

Abstract:
Constructive type theory represents, on one hand, the framework which joins logic and programming languages in one elegant way; that way program development and its verification may execute as one system. On the other hand, type theory may be considered as a functional programming language with some new properties. Under certain conditions it is possible to define a system which is a logical system and programming language all in one, and within which statements and types are equivalent, as if the proofs of the statements and elements of types.
In this lecture we are going to consider some basic facts about constructive logic, untyped and typed lambda calculus, and after

that we are going to see what are the rules that form a basis of a type theory, and to learn some basic facts and propositions of the type theory, ending with Curry Howard isomorphism.

- **Milena Vujošević-Janičić** (The Faculty of Mathematics, University of Belgrade)
  Automated Detection of Buffer Overflows in Programming Language C

  Abstract:
  Automated detection of buffer overflow bugs in C programs is very important problem because buffer overflows are suitable targets for security attacks and sources of serious programs' misbehavior. Buffer overflow bugs can be detected in run-time by dynamic analysis of the program being executed, and before run-time by static analysis of the source code. In this talk we will present our new static system for automated detection of buffer overflows. The system is flow-sensitive and inter-procedural, and it deals with both statically and dynamically allocated buffers. Its architecture is flexible and pluggable. For instance, the system uses an external and easy-extendable knowledge database that stores all the reasoning rules so they are not hard-coded within the system. Also, for checking generated correctness and incorrectness conditions, any external automated theorem prover that follows SMT-LIB standards can be used. We will also report on our prototype implementation - the FADO tool.

16.01.2008.

- **Goran Predović** (Microsoft Development Center Serbia)
  Tutorial: Automated Geometry Theorem Proving using Algebraic Methods

  Abstract:
  Although the connection between geometry and algebra is determined in seventeenth century (Rene Dekart), theory for proving geometry theorems that are formulated using algebraic notations was developed only at the end of the twentieth century. At that time, successful results were reported by the Chinese mathematicians Wen-Tsus Wu. Algebraic methods proved to be very powerful, able to prove hundreds of non-trivial geometry theorems and discovering new ones. First part of the lecture is basic introduction into Automated Geometry Theorem Proving. Second part of the lecture is the presentation of the two most successful algebraic methods - Wu's method and the Groebner basis method. Finally, integration of the implemented geometry provers into GCLC system will be demonstrated.

- **Filip Marić** (The Faculty of Mathematics, University of Belgrade)
  Automatic Timetabling by using a SAT encoding

  Abstract:
  This lecture will describe a case study of automated timetabling on Faculty of Mathematics. Conditions of timetable are encoded with a propositional formula and a SAT solver is used to find its models, which represent valid timetable solutions.

29.01.2008. - 01.02.2008.

Workshop on Formal Theorem Proving

- Filip Marić (The Faculty of Mathematics, University of Belgrade):
  "Formal Verification of SAT Solvers"
- Predrag Janičić
  (The Faculty of Mathematics, University of Belgrade):
  "ARGO Group Presentation"

12.03.2008.

- **Bojan Marinković** (Mathematical Institute of the Serbian Academy of Sciences and Arts)
  Tutorial: An Introduction to the Analysis of Algorithms

  Abstract:
  Cause of this lecture is to present an oversee of the book "An Introduction to the Analysis of Algorithms" of R. Sedgewick and P. Flajolet. This lecture is part of exam for post graduated course "Theoretical computer science" at The Faculty of Mathematics of University of Belgrade.

- **Petar Maksimović** (Mathematical Institute of the Serbian Academy of Sciences and Arts)
  Simple Characterization of Functionally Complete One-Element Sets of Propositional Connectives

  Abstract:
  A set of propositional connectives is said to be functionally complete if all propositional formulae can be expressed using only connectives from that set. In this paper we give sufficient and necessary conditions for a one-element set of propositional connectives to be functionally complete. These conditions provide a simple and elegant characterization of functionally complete one-element sets of propositional connectives (of arbitrary arity).

02.04.2008.

- **Jelena Tomašević** (The Faculty of Mathematics, University of Belgrade)
  Tutorial: XML databases

  Abstract:
  For the past few years Extensible Markup Language (XML) has become dominant standard for describing and exchanging data over Internet. But on the other hand XML has introduced several new problems. The more pressing problems are how to store and manage XML data. Regarding rigidity of XML document structure, XML documents fall into two broad categories: data-centric and document-centric. When dealing with data-centric XML documents, it is possible to convert XML documents into a relational database, which can then be queried using SQL. Such relational databases are called XML-enabled databases. Document-centric XML documents are those characterized by irregular structure and mixed content. The best choice for storing, updating and retrieving these kind of XML documents is usually a native XML database (NXD). Basic characteristics of an NXD are the following:
  - A logical unit of an NXD is an XML document or its rooted part, and it corresponds to a row in a relational database.
  - It includes at least the following components: elements, attributes, textual data (PCDATA), and document order.
  - Physical model (and type of persistent NXD storage) is unspecified.

  NXDs store XML documents as logical units, and retrieve documents using specific query languages such as XPath or XQuery.

- **Vladan Radivojević** (PhD student at the Faculty of Mathematics, University of Belgrade)
  Small axiomatic systems

  Abstract:
  One way to formulate propositional logic is the L theory which consists of one rule of inference and three axioms over two connectives. There are smaller axiomatic systems equivalent to the L theory with the same rule of inference and same set of connectives. For instance, the system which was discovered by C.A. Meredith in 1953. consists of only a single axiom. In 1917. J. Nicod discovered even simplier system with the single axiom schema in which the only connective is the Sheffer stroke.
  This article is about these "small" axiomatic systems and about some properties of formulas with the Sheffer stroke.

19.04.2008. - 25.04.2008.

Spring School Geometry and Visualization

- Predrag Janičić

(The Faculty of Mathematics, University of Belgrade):
"Intelligent Geometrical Software"

- Vesna Pavlović, Sana Stojanović
(The Faculty of Mathematics, University of Belgrade):
"Formalization and Automation of Euclidean Geometry"
- Predrag Janičić
(The Faculty of Mathematics, University of Belgrade):
"GCLC - lab session"

16.04.2008.

- **Prof. Steve A. Quarrie** (Director of the Consultative Bureau for International Projects, Ministry of Science, Serbia)
FP7 and looking for the truth: you mathematicians have it easy!

  Abstract:
  What is the relevance of FP7 to young researchers and PhD students? FP7 has a lot of opportunities for young scientists to improve their research skills, but the best FP7 money goes to only the very best quality research. The talk will focus on how you ensure that you are doing the best quality research. Developing effective research skills needs constant help and support to understand what to do and, more importantly, why. The purpose of the post-graduate education is to teach PhD students how to THINK and to become RELIABLE as independent workers using RESEARCH as the vehicle for these goals. Research is looking for the TRUTH and a key to finding the truth is good experimental design. Examples will be presented of how to design experiments to enable you to find the truth and to recognise when you have found it. You will learn something about cheese, ozone, wheat and Canadian burglars!

14.05.2008.

- **Prof. Pedro Quaresma** (University of Coimbra, Portugal)
Cryptology - a (very) Brief Survey

  Abstract:
  Cryptology is the the science of the enciphering and deciphering of messages in a secret code or cipher, the cryptography, and also the science (and art) of recovering information from ciphers without knowledge of the key, the cryptoanalysis. A brief presentation of this dual process of hidden/cracking the information, from the classical ciphers, to the modern symmetric, and public key ciphers will be presented.

04.06.2008.

- **Mladen Nikolić** (The Faculty of Mathematics, University of Belgrade)
  Methodology of Parameter Values Setting for SAT Solvers

  Abstract:
  Some aspects of SAT solver functioning can be defined by different parameters of those solvers. Performance of a solver depends on boolean formula being solved and on choice of it's parameter values. Therefore, a methodology for choosing parameter values is needed. Such a methodology should take into account properties of the problem instance being solved. Approach we take is based on representing formulae as graphs and using graph similarity measures in order to find good parameter values for solving the unknown formula. Those would be the values for which SAT solver efficiently solves the similar formulae.

- **Vesna Pavlović, Sana Stojanović** (The Faculty of Mathematics, University of Belgrade)
  Formalization and Automation of Euclidean Geometry

  Abstract:
  The idea of formalization of geometrical reasoning is present from recent days and it is still in its beginnings, so it presents the area which is expected to be in the focus in the following years. Some of the authors succeeded in formalizing one part of Hilbert's axioms, and also part of Tarski's axioms and in formalizing some of the theorems that belong to these groups of axioms. The objective of our research is automation of this process and obtaining along formal verification of the proof in Isabelle proof assistant.

18.06.2008.

- **Panel discussion:** ()
  Current research issues

  Abstract:
  Discussion on research problems that we worked on during the past academic year, that we work on now, and that we are planning to work on.

ICCL — Dresden, August 2008

Vesna Pavlović

10.10.2008.

The Sixth ICCL Summer School 2008 was held in Dresden, and it lasted from August 24 until September 06. There were about 40 attendees from all over the world, mainly PhD students in computer science and philosophy.

The main focus of the summer school was the relationship between modern formal logic and common sense underlying human reasoning. Psychological experiments done in the past suggested that logic seems to play a very small role in human reasoning, but recently some new explanations of human reasoning were suggested which revived interest for logic.

The web page of the summer school is:
`http://www.computational-logic.org/content/events/iccl-ss-2008/index.php?id=24`.

1 Talks

There were eight courses during these two weeks and here I present just a couple of them that were most interesting to me.

1.1 Computational Logic in Human Reasoning

Robert Kowalski

Although originally developed as a model of human reasoning, some experiments (for example Wason selection task) suggested that formal logic is not present in human reasoning in such amount as we would expect. Kowalski gave a review of some psychological literature on human thinking and argued that computational logic can be used to model both intuitive and deliberative thinking. Also a kind of tutorial on logic programming, abductive logic programming and production systems was given, with many interesting examples. At the end we found out what is the meaning of life (for a wood louse :)).

1.2 Logic-based Agents

Fariba Sadri

Professor Sadri gave a brief tutorial on logic-based agents and argued that computational logic can be used to implement their functionalities. "Thinking" of intelligent agent can be modeled using forward chaining with production rules. She described few agent models, including Teleo-Reactive agents, Agent-0 and AgentSpeak(L). She showed us that it is possible to model such an agent models with logic-based agents that use abductive logic programming as their "thinking" component.

Slika 1: Interior of the Computer Science Faculty Building of Technische Universitat Dresden

1.3 Computational Logic and Cognitive Science

Kai-Uwe Kuhnberger, Helmar Gust

On the very beginning of the course the examples of human reasoning that seem hard to be modeled with classical logic were given (they include Wason selection task, analogical reasoning, learning natural languages, etc). Solutions that were proposed include usage of non-monotonic logics, frameworks for analogical reasoning and model-based reasoning.

1.4 Computational Logic Applications in Cognitive Science

Luis Moniz Pereira

The lecturer gave a talk concerning modeling of moral reasoning and decision making through exploring uncertain future outcomes. As an example we saw a demo of the game in which the robot has to save the princess from the castle. The castle is on the other side of the river and there are two bridges, one guarded by a huge spider and the other by a ninja. So the robot had to make a decision whom to attack in order to save the princess. He thought about it for a while, then he realized that he is stronger than the ninja, so he attacked ninja first but once he killed him, he made the princess very angry because she found it immoral to kill a human. So he had to go back. Then he tried to kill a spider, but the spider was stronger than him, so he died.

1.5 Human Reasoning and Cognitive Science

Michiel van Lambalgen

This series of lectures was based on the book of the lecturer and his colleague Keith Stenning at MIT Press. The authors showed that it is possible to model data used in psychology of deductive reasoning using defeasible logic 'logic programming with negation as failure'. In my opinion he was the best lecturer at this summer school.

2 Miscellaneous

Organization of this summer school was at very high level. There was a short break between every two lectures with coffee, juice and cookies. On the first day the main organizer prof. Holldobler showed us few places with good and cheep food that were close to department. We usually ate in student's mensa that looks incredibly good (that was also an opinion of a few guys from Germany). The average price for a meal was 5 Euros.

Slika 2: Historical Part of the City of Dresden

Social events were organized every second-third day. Firstly, on the day of arrival, there was a city tour (which I unfortunately missed because I came too late in the evening). On the third day we went to listen to a concert in Semperoper, which is one of the most famous opera houses in Germany. We also went to Meissen - the place where first European porcelain was manufactured in 1710, and to Moritzburg where we visited the castle (first of many we actually went to) that was built in 16th century as a hunting lodge for one of their dukes. We also had a hiking tour to Saxon Switzerland which is in my opinion a must see if you go to Dresden, and it was also fun, especially the waterfall which flushed by giving 50 cents to the people in kiosk nearby :). On the last day of

school we had a conference dinner in Eckberg castle which started with serving champagne in the garden and continued with a dinner inside the castle where some fancy food was served. Organization of all these events was at highest level.

The group of people attending this summer school was very diverse (there was someone from each continent), it consisted mainly of PhD students in computer science and philosophy, but also master students in computational logic and some post-docs. Everyone was interested to talk about his/hers research topics and to find out what are the topics of someone else's work. We also went out almost every evening in order to discover the city and many opportunities that it offers (for example jazz concerts, museum exhibitions, karaoke night, cycling tours etc). The ticket for the jazz concert in Semperoper was 20 Euros and an average price for a drink in a club was 5 Euros.

The city of Dresden itself made a great impression on me, I find it very nice to live there (especially for students), because it is small enough to learn it in few days, but again big enough that you don't get bored. The river Elbe runs through the city, and one can also enjoy in different exhibitions that take place in Zwinger palace. Unfortunately, all the museums close at 6PM.

The price of the airplane ticket for round trip Belgrade-Berlin with a national air company (JAT) was about 300 Euros, and the train ticket from Berlin to Dresden was 35 Euros.

Beleške za doktorat: Primene mašinskog učenja za ubrzavanje SAT rešavača

Mladen Nikolić

10.10.2008.

1 Dalja analiza do sada sakupljenih podataka

U magistraturi je sakupljena velika količina podataka o funkcionisanju sat rešavača sa različitim vrednostima parametara i na različitim vrstama iskaznih formula. Kako je postupak sproveden sistematično, može se smatrati da se raspolaže kvalitetnim uzorkom nad kojim se mogu primenjivati različite tehnike istraživanje podataka ili statističke analize. Jedno pitanje na koje bi se mogao tražiti odgovor je koje vrednosti parametara se međusobno dobro slažu i koje vrednosti ne bi trebalo kombinovati.

Još jedna tema od potencijalnog istraživačkog značaja koja bi se mogla sprovesti na osnovu već sakupljenih podataka je proučavanje uticaja preimenovanja promenljivih i permutovanja klauza na vreme rešavanja formula. Bilo bi zanimljivo sprovesti takvu analizu u zavisnosti od familije kojoj formula pripada i u zavisnosti od vrednosti parametara sa kojima je formula rešena.

2 Stohastička optimizacija parametara

Broj parametara i njihovih dopustivih vrednosti u magistraturi se može smatrati relativno malim, pa je moguće da za razne formule postoje kombinacije vrednosti parametara za koje bi rešavač postizao bolje performanse. Najjednostavniji nastavak bi bio povećavanje broja razmatranih parametara i njihovih dopustivih vrednosti. Pri tome bi bilo potrebno paziti na povećanje računske zahtevnosti. Dosta efikasnije rešenje bi bilo korišćenje stohastičkih metoda lokalne pretrage kao u radu [**?**], pošto se ovaj pristup pokazao kao vrlo uspešan u pronalaženju dobrih vrednosti parametara za datu familju. U kombinaciji sa metodom klasifikacije visoke preciznosti koja je opisana u ovom radu, takav pristup bi mogao da da vrlo dobre rezultate u praksi.

S obzirom da stohastičke metode pretrage omogućavaju rad sa mnogo većim brojem parametara nego sistematično rešavanje, za analizu odnosa ovih parametara bi se mogle koristiti statističke metode. Na taj način bi se moglo doći do znanja o tome koje vrednosti parametara dobro funkcionišu jedne sa drugima.

3 Ispitivanje stabilnosti najboljih vrednosti parametara u regionu fazne promene za 3-SAT

Planirano je rešavanje instanci problema 3-SAT. Cilj ovog istraživanja je ispitivanje stabilnosti najboljih vrednosti parametara kada se instance problema približavaju tački fazne promene. Time bi se došlo do novih informacija o razlici u funkcionisanju SAT rešavača u blizini tačke fazne promene i daleko od nje. Koristila bi se stohastička optimizacija parametara, a bila bi vršena i klasifikacija formula na teške i lake, pošto odnos broja klauza i varijabli u regionu fazne promene ne mora uvek označavati tešku formulu[1].

4 Učenje upravljanja SAT rešavačem

Pomenuti pravci daljeg rada ili predstavljaju primenu metodologije iz magistrature sa drugačijim parametrima ili domenom ili se direktno oslanjaju na podatke prikupljene u dosadašnjem istraživanju. Nešto drugaciji pristup bi se umesto na prilagođavanju polaznih parametara bazirao na konstantnom prilagođavanju rešavača u toku procesa rešavanja. Naime, rad rešavača bi se mogao modelirati Markovljevim procesom odlučivanja. Za učenje optimalnih politika odlučivanja u Markovljevim procesima odlučivanja koristi se tehnika učenja uslovljavanjem. Na taj način bi se mogla naučiti optimalna politika upravljanja rešavačem ukoliko se definiše skup stanja procesa odlučivanja i skupovi akcija koje se mogu preduzeti u različitim stanjima. U svakom trenutku rada, rešavač se nalazi u nekom stanju koje je definisano vrednostima određenih veličina kao što su na primer broj promenljivih kojima je dodeljena vrednost, broj konflikata od poslednjeg restarta, broj naučenih klauza i slično. Tačan izbor veličina koje bi trebalo uključiti u definiciju stanja rešavača je jedan od važnijih istraživačkih izazova pošto značajno utiče na broj stanja, a samim tim i na efikasnost učenja uslovljavanjem koje ima eksponencijalnu složenost u zavisnosti od broja stanja. Stoga je potrebno identifikovati minimalan ili približno minimalan skup veličina i njihovih dopustivih vrednosti koje bi definisale stanja. Bilo bi prirodno i da stanja predstavljaju ne pojedinačne vrednosti ovih veličina već njihove skupove konstruisane na osnovu nekog teorijskog predznanja. Tako bi se broj stanja mogao značajno smanjiti. Što se tiče dopustivih akcija, one generlano mogu da variraju od stanja do stanja i potrebno ih je preciznije formulisati, ali se mogu razmatrati dva nivoa apstraktnosti odluka. U apstraktnijem pristupu bi se za akcije mogle uzeti promene politika koje se smatraju pogodnim u različitim stanjima. Aliternativni pristup koji bi bio teži za osmišljavanje i implementaciju, ali sa većim potencijalom, bi bio da se za akcije uzmu konkretne akcije u okviru rešavača, kao što su restartovanje u datom trenutku, zaboravljanje klauza i slično. Za učenje bi ponovo bile korišćene formule iz nekog reprezentativnog korpusa.

Planirani pristup učenju upravljanja rešavačem bi se mogao kombinovati sa metodologijom iz magistrature kako bi se u startu izabrali povoljniji parametri, ali bi jedan od bitnih zahteva novog pristupa morao biti da se rešavač u prihvatljivom vremenu prilagodi datoj formuli bez obzira na polazne parametre.

[1] Možda ipak regresija? Ovo je osnovni Hutter-ov pristup. Stvar je dobrim delom urađena.

5 Prepoznavanje backdoor promenljivih radi efikasnijeg izbora promenljive

Ukoliko za neki skup promenljivih date formule postoji dodela vrednosti kojom se rešavanje ostatka formule može svesti na polinomijalan problem, onda se te promenljive nazivaju backdoor promenljivim te formule u odnosu na polinomijalni algoritam rešavanja. Ukoliko bi se za iskazne promenljive definisale neke karakteristke, mogla bi se vrsiti klasifikacija vektora karakteristika promenljivih u dve klase - jeste backdoor ili nije backdoor promenljiva. Naravno, trening skup bi morao biti konstruisan rešavanjem većeg broja formula i nalaženjem njihovih backdoor promenljivih. Bilo bi pogodno da se pored odgovra da/ne može dobiti i rangiranje promenljivih prema tome koliko je moguće da predstavljaju backdoor promenljivu. U tom slučaju je jasno definisana politika izbora varijable.

Što se tiče karakteristika promenljivih, potrebno je pronaći u literaturi da li se već neke javljaju, ali neke polazne bi mogle biti:

- Procenat klauza u kojima promanljiva učestvuje.
- Procenat ukupnog broja klauza u kojima je promenljiva negirana.
- Procenat ukupnog broja klauza u kojima je promenljiva nenegirana.
- Procenat broja pojavljivanja promenljive u kojima je ona negirana.
- Procenat broja pojavljivanja promenljive u kojima je ona nenegirana.
- Odnos broja negiranih i nenegiranih pojavljivanja promenljive.
- Stepen čvora koji odgovara promenljivoj u grafu promenljivih i klauza.
- Stepen čvora koji odgovara promenljivoj u grafu promenljivih.
- Broj literala u klauzama u kojima promenljiva učestvuje: prosek, disperzija, minimum, maksimum, entropija.
- Isto za reciprocan broj literala, a onda sve to po pozitivnim i po negativnim pojavljivanjima.
- Udeo binarnih, ternarnih i hornovih klauza u klauzama u kojima promenljiva figurise i sve to po negiranim i nenegiranim.
- Statistike vezane za konflikte u kojima promenljiva učestvuje prilikom probnog pokretanja SAT rešavača.

Pokusati i sa ubacivanjem raznih karakteristika formule. Smisao ubacivanja tih karakteristika je da daju kontekst karakteristikama promenljive.

Nad svim navedenim karakteristikama, izvršiti izbor relevantnih karakteristika ili pomoću neke statističke metode ili grubom silom.

6 Plitko rešavanje i izbor polariteta promenljive

Pod plitkim rešavanjem podrazumevam pogađanje zadovoljavajuće valuacije za neku formulu. Poenta nije u brzom rešavanju formule pošto je to verovatno previše teško, već u tome što takva valuacija definiše potencijalno dobru politiku izbora polariteta. Za veći broj formula bi bili nađeni svi njihovi modeli i formirani vektori karakteristika formula sa njihovim pridruženim vrednostima u nađenim modelima. Klasifikovanje promenljivih iz nerešene formule na osnovu njihovih karakteristika bi dalo predlog valuacije. Ukoliko ona nije zadovoljavajuća, mogla bi se koristiti kao politika izbora promenljive pošto je moguće da je broj loših dodela vrednosti mali.

Visit to University of Rome ,,La Sapienza“, November 2008

Predrag Janičić

16.11.2008.

Following an invitation by prof. Stefano Marchiafava, I visited the University of Rome ,,La Sapienza“ in the period from November 9 till November 16, 2008. The main purpose of my visit was to present my tool GCLC. There were several people interested in using it their courses.

1 Department of Mathematics of University of Rome ,,La Sapienza“

The University of Rome ,,La Sapienza“ (*wisdom*) was until recently the only public university in Rome. Now there are also ,,Roma 2“ and ,,Roma 3“, but ,,La Sapienza“ remains the biggest university in Italy (with around 100000 students). It is also one of the oldest ones.

The Department of Mathematics has a very long and successful history. It houses a huge mathematical library, now under the state's protection. Computer science fields were separated some years ago to form a Department of Informatics.

The university has a campus very close to the city center and the Department of Mathematics has its own building within the campus.

2 My Talks

During my visit to Rome, I gave two lectures. They were scheduled as special events, not as a part of regular semesters, but were announced by the group for topological algebra and differential geometry and by the group for dynamic geometrical software.

Both times the audience consisted of senior lecturers only, with geometry, mathematical logic, and didactics as their main research fields. Both times there were very interesting discussions, lasting half an hour after the first talk and more then one hour after the second talk. Some of the questions and my answers are summarized in the following subsection.

I also had separate meetings with Stefano Marchiafava, mostly related to different aspects of GCLC, and with Peter Lorence, who is interested in symbolic computations in geometrical software (although he uses Mathematica, so my experiences with C++ were not very useful to him).

Slika 1: Department of Mathematics, University of Roma ,,La Sapienza“

2.1 Dynamic Geometry Software and GCLC, November 11, 2008

During this talk, I gave a brief overview of dynamic geometry software and then presented GCLC, some of its features and some interesting examples. There were several people in the audience that use Cabri, so one of the most interesting issues was to compare GCLC and Cabri. Here are some questions and answers summarized:

Q: You said that GCLC language is simple, but I think it is not simple for students. Anyway, the recursion is interesting, you can't do that in Cabri.]

A: True, GCLC is not for primary school pupils, yet I think it can be suitable for secondary schools and universities.

Q: Can you move points in 3D?

A: No.

Q: Can you export 3D images?

A: Yes.

Q: How do you make LaTeX figures?

A: Just use the Export option and it can give a LaTeX file.

Q: You have intersections of two lines. Can you have intersections of arbitrary objects?

A: No, for instance, one cannot have intersection of a line and a locus.

Q: Neither Cabri can do that. But in Cabri you can select a point on a locus.

A: In GCLC you can do that too.

Q: Did you make whole of this program?

A: Yes, most of it.

Q: Can you move a point along some curve?

A: I can simulate that.

Q: Can you move two points in the same time?

A: Yes, like this...

Q: Cabri cannot do that.

2.2 Automated Geometrical Reasoning within GCLC, November 13, 2008

During this talk, I gave an overview of methods of automated theorem proving in Euclidean geometry, with a special focus on the area method, Wu's method, and Gröbner bases method. Then I presented the provers built into GCLC, some of its features and some interesting examples. Here are some questions and answers summarized:

Q: You said the coordinates are not used, but there are coordinates in the GCLC files?

A: Yes, but they are used only for visualization, not for deduction.

Q: Can the area method prove all constructive statements?

A: No, only those you can express. Also, intersections with circles are not supported. But, for its domain it is a decision procedure.

Q: The theory that you use involves arithmetic and the Gödel theorem says it cannot be decidable?

A: The arithmetic used is over reals and it is decidable.

Q: Other two methods also cannot prove all constructive statements. Is it possible to know in advance that they will fail?

A: For the area method, it is possible — it can be seen that a conjecture is out of the scope. But, for the algebraic provers it is extremely difficult to make such characterization.

Q: What happens when a conjecture is out of scope of an algebraic prover?

A: Sometimes they just fail, sometimes they loop.

Q: Is it possible to transform proof generated by the area method to a traditional geometrical proof?

A: In principle — yes, because there is a link between the corresponding axiomatic systems, but in practice — no, such proofs would be too long and unreadable.

Q: Can you describe specific constraints, like "a quadrilateral is convex"and such?

A: Yes — for that specific one: a quadrilateral $ABCD$ is convex if and only if $S_{ABCD} = S_{ABD} + S_{BCD}$. In general — you also have to find similar ways to express specific conditions.

3 Eternal Rome

Rome is just so gorgeous that it is shame not to see some of it even if you are there on a business trip. If you don't have enough time for that, you should also not worry too much — no matter how much time you have for visiting, your last day in Rome you will feel frustrated as you didn't visited everything you wanted to. So, just relax, enjoy, throw a coin to Fontana di Trevi above your shoulder and hope that you will be here again. And you should be indeed, as this must be one of the most beautiful cities in the world, and probably the most important one from the historical point of view.

Slika 2: The Arch of Constantine

For those who visit Rome for the first time, *a must* see destinations include the Colosseum and the Roman Forum, the city of Vatican and its museums, while there is also a favorite tourists' destination Fontana di Trevi (the crowd there always reminds me of a flock of penguins staying steadily). My highlights during this visit were Pantheon (I hadn't visited it before) and the retrospective exhibition of Jiovani Bellini (one of my favorite painters).

The prices are higher than in Belgrade, but somewhat lower than in some other western European countries. You can have a very nice dinner in a local restaurant (very often with a better food) for 10-20 Euros, while in the city center it would be 20-30. Drinks are usually from 2 to 4 Euros. In local coffee shops or student cafeteria, you can have a breakfast for 2-4 Euros, and you can have a decent lunch in a student mensa for 10 Euros. I had an accommodation in the university residence, so it was very affordable — 25 Euros per night, I guess the prices for other types of accommodation are significantly higher. One-day ticket for all public transport costs 4 euros.

There is a convenient direct flight Belgrade-Rome, you are there in just one hour and a quarter... but, it can also take more than one day... On my departure day, l'Italia's pilots were on strike, so my flight was cancelled, they provided me a hotel in small town Oviedo near the airport and an indirect flight via Munich (where I am at the moment while writing these lines).

Foundations of Information Technologies, Faculty of Technical Sciences, Novi Sad, June 2009

Milena Vujošević-Janičić

30.06.2009.

The Summer School on Foundations of Information Technologies, FIT, was held in Novi Sad, in Serbia, between June 14 and June 27, 2009. It was organized by the Faculty of Technical Sciences, Novi Sad. There were about 40 attendees, mostly from Serbia (Belgrade, Novi Sad, Novi Pazar), but also from Italy and Bosnia and Hercegovina.

Summer school consisted of six courses that were organized into three modules. The first module was focused on 3D graphics, the second was focused on theoretical grounds on term rewriting and semantics of programming languages, and the third was focused on computer networks.

The web page of the summer school is: `http://cms.ns.ac.yu/fit2009/`

1 Talks

I attended two courses that I present here.

1.1 Semantics of Programming Languages

Furio Honsell, Pietro Di Gianantonio

The course presented an introduction to operational and denotational semantics of programming languages. The aim of the course was to present motivations, basic techniques, and main ideas of formal semantics of programs. The language considered was a simple imperative language, the CCS and the lambda calculus; the later two are the paradigms for concurrent and functional programming. Course also presented the main mathematical tools (algebras and coalgebras in category theory) that are used in this field.

1.2 Introduction to Term Rewriting: Techniques and Applications

Salvador Lucas

Term rewriting techniques are used in many fields of computer science: software engineering, programming languages, program verification, automated deduction, and (computer) algebra, among others. The course presented an overview of the field, emphasizing the essential features of term rewriting and term rewriting systems which are crucial to understand rewriting-based programming languages, programs, and computational systems. The analysis

and automatic proof of confluence and termination properties of term rewriting systems were considered.

2 Miscellaneous

Organization of the summer school was very good. One lecture lasted for around one hour and a half and between every two lectures there was a coffee break. Organizers took participants every day to a different restaurant for lunch and almost all participants had lunch together. All the prices in Novi Sad are smaller than in Belgrade.

The summer school dinner was organized in restaurant Plava Frajla. It lasted quite long (from 8pm to 1am) and most of the participants went to a disco after the diner (I went to hotel to sleep). The dinner was nice and the atmosphere was friendly.

I stayed in hotel Mediteraneo that is placed in a city center. The price of the hotel was 5515 dinars (around 55 euros) and this price included a breakfast (that was not in the same building). The hotel is okay, it has its own parking lot (which is very important since the hotel is in "redžone) and wireless internet access in all rooms. `www.hotelmediteraneo.rs`

It is easy to drive through Novi Sad because there are names of streets written at every cross road. The people in Novi Sad are very friendly and they helped me a lot to find places that I was looking for. I needed one hour to get from New Belgrade to Novi Sad and 20 more minutes to find university campus in Novi Sad.

ARGO seminar 2008/2009

Milan Banković

28.06.2008.

Argo seminar je seminar Argo grupe. Bavi se uglavnom, ali ne isključivo, automatskim rezonovanjem i primenama, teorijskim računarstvom, veštačkom inteligencijom i data-mining-om. Seminar je posvećen uglavnom studentima poslediplomcima. U principu, prvi deo seminara je tutorijalski, u drugom se izlažu istraživački problemi.

Sastanci se održavaju jednom u dve nedelje, uglavnom sredom u 17h u prostorijama Matematičkog fakulteta u Jagićevoj ulici.

Argo seminar se održava od akademske godine 2007/08.

Rukovodilac seminara je Predrag Janičić, a sekretar seminara Vesna Pavlović.

1 Održana predavanja

5.11.2008.

- **Vesna Pavlović** (Matematički fakultet, Univerzitet u Beogradu)
  Izveštaj sa Letnje škole ICCL 2008, Dresden

  Apstrakt:
  Šesta po redu ICCL letnja škola održana je u Dresdenu u periodu od 24. avgusta do 6. septembra u organizaciji TU Dresden. Glavna tematika letnje škole bio je odnosizmedju moderne formalne logike i zdravog razuma koji karakteriše ljudsko rasudjivanje. Na predavanju će biti ukratko prikazane osnovne ideje razmatrane na ovoj letnjoj školi.

- **Damjan Krstajić** (Istraživački centar za hemijsku informatiku)
  Discovery Bus - sistem za automatsko pravljenje QSAR modela

  Apstrakt:
  Postoji više različitih načina i pristupa prilikom pravljenja statističkih/QSAR modela. Bez obzira na naše preference, praksa nas uči dane postoji jedno rešenje koje daje najbolje rezultate u svim situacijama. Sa druge strane, sa razvojem robotizovanih laboratorija u situaciji smo daimamo konstantan priliv eksperimentalnih rezultata. Izazov nam je bio da napravimo sistem koji će da se nosi sa konstantnim prilivom novih podataka i koji će automatizovati pravljenje statističkih/QSAR modela. Discovery Bus je naš odgovor tom izazovu. To je implementacija

Competitive Workflow arhitekture koja se bazira na autonomnim softver agentima.

19.11.2008.

- **Mladen Nikolić** (Matematički fakultet, Univerzitet u Beogradu)
  Tutorijal: Linearna regresija i njena primena u ubrzavanju SAT rešavača

  Apstrakt:
  Regresija je postupak odredjivanja funkcije koja približno povezuje vrednosti dve slučajne promenljive. Najčešće je ta funkcija definisana skupom parametara čijim se fiksiranjem bira jedna iz unapred definisanog skupa. Ovaj izbor se vrši na osnovu datih trening podataka. Ukoliko su sve dopustive funkcije linearne po svojim parametrima, regresija se naziva linearnom. Taj problem se obično rešava minimizacijom srednjekvadratne greške metodom najmanjih kvadrata uz eventualnu regularizaciju problema. Jedna od primena linearne regresije je predikcija vremena rešavanja diskretnih problema kao što je SAT na osnovu nekih karakteristika instance koja se rešava.

- **Milan Banković** (Matematički fakultet, Univerzitet u Beogradu)
  Alldifferent SMT rešavač

  Apstrakt:
  Programiranje ograničenja je istraživačka oblast koja poslednjih godina sve više dobija na značaju zbog svoje fleksibilnosti i široke oblasti primene. U pitanju je deklarativni stil programiranja u kome se problem definiše skupom ograničenja koje njegovo rešenje mora da zadovoljava. Rešavanje ovakvog problema se svodi na pronalaženje vrednosti promenljivih koje zadovoljavaju sva data ograničenja. Jedno od najpoznatijih i najčešćih ograničenja je tzv. `alldifferent` ograničenje koje zahteva da nikoje dve promenljive iz datog skupa promenljivih ne mogu uzeti jednake vrednosti. Poseban izazov predstavlja povezivanje programiranja ograničenja i SAT problema, koristeci SMT pristup. U ovom izlaganju ćemo dati kratak opis `alldifferent` ograničenja, povezujuci ga sa teorijom uparivanja u bipartitnim grafovima. Zatim ćemo uspostaviti vezu `alldifferent` ograničenja i SAT problema, predstavljajući ovo ograničenje kao SMT problem. Na kraju ćemo dati predlog algoritma za generisanje objašnjenja propagacija u `alldifferent` SMT rešavaču.

03.12.2008.

- **Predrag Janičić** (Matematički fakultet, Univerzitet u Beogradu)
  Poseta Univerzitetu u Rimu i prezentacija paketa GCLC

Apstrakt:
U izlaganju će biti dat osvrt na skorašnju posetu Matematičkom fakultetu Univerziteta u Rimu. Biće ukratko ponovljena i dva predavanja o paketu GCLC koja su tamo održana. Posebno će biti reči o mogućim pravcima daljeg razvoja GCLC-a.

- **Panel diskusija** ()
  Aktuelne i planirane istraživačke teme

  Apstrakt:
  Diskusija o tekućim i planiranim istraživačkim problemima, posebno o aspektima potencijalno interesantnim novim studentima doktorskih studija.

24.12.2008.

- **Staša Vujičić** (Matematički fakultet, Univerzitet u Beogradu)
  Tutorijal: Genetski algoritmi

  Apstrakt:
  Genetski algoritmi su pristup mašinskom učenju baziran nasimuliranju evolucije. Hipoteze se najčešće reprezentuju nizovima bitova čija interpretacija zavisi od aplikacije, mada mogu biti reprezentovane i simboličkim izrazima ili čak računarskim programima. Potraga za odgovarajućom hipotezom počinje populacijom, to jest skupom inicijalnih hipoteza. Članovi trenutne populacije utiču na razvoj naredne generacije putem operatora ukrštanja i mutacije, koji su definisani po uzoru na procese u biološkoj evoluciji. U svakom koraku,hipoteze u trenutnoj populaciji se procenjuju na osnovu mere prilagodjenosti, gde se najbolje prilagodjene hipoteze biraju za proizvodnju naredne generacije. Genetski algoritmi se uspešno primenjuju u nizu problema učenja i problema optimizacije. Na primer, koriste se za učenje skupa pravila za kontrolu robota i za optimizaciju topologije i parametara učenja za veštačke neuronske mreže. U ovom radu prikazana je varijanta genetskih algoritama, u kojoj se hipoteze reprezentuju kao nizovi bitova i varijanta genetskog programiranja, u kojoj se hipoteze reprezentuju pomoću programa.

- **Bojan Marinković** (Matematički institut SANU)
  Logika sa operatorom uslovne verovatnoće

  Apstrakt:
  Tokom avgusta meseca 2008. godine u Hamburgu je održana letnja škola ESSLLI 2008. Grupa mladih istraživača Matematičkog instituta SANU predstavila je svoj rad u okviru studentske sesije na ovoj letnjoj školi. Tokom ovog izlaganja biće predstavljen sam rad koji dajesaglasnu i jaku kompletnost aksiomatizacije za rezonovanje o linearnoj kombinaciji uslovnih verovatnoća, odlučivost

sa procedurom odlučivanja u klasi PSPACE, kao i informacije o samoj letnjoj školi.

25.02.2009.

- **Aljoša Obuljen** (Matematički fakultet, Univerzitet u Beogradu)
  Tutorijal: Bajesovsko ucenje

  Apstrakt:
  Ovaj tekst predstavlja kratak pregled oblasti bajesovskog učenja (eng. Bayesian learning). Bajesovski pristup mašinskom učenju je pogodan kada je potrebno analizirati podatke i donositi odluke na osnovu teorije verovatnoće. Ovaj pristup je važan kako za odredjivanje merodavnosti podataka koji idu u prilog hipotezi koja se razmatra koristeći teoriju verovatnoće, tako i u uporednoj analizi različitih metoda mašinskog učenja.

- **Predrag Janičić** (Matematički fakultet, Univerzitet u Beogradu)
  Uniformno svodjenje teških problema na SAT

  Apstrakt:
  U izlaganju će biti predstavljen jedan uniforman pristup za svodjenje teških problema na SAT. Pristup koristi ideju preopterećivanja operatora u objektno-orijentisanom programiranju. Pristup je već korišćen na kriptoanalitičkim problemima (zajednički rad sa Dejanom Jovanovićem i Milanom Šešumom). Biće opisano kako dodatni tipovi problema, sa posebnim naglaskom na NP-kompletne probleme, mogu biti obradjivani na sličan način.

18.03.2009.

- **Sana Stojanović, Vesna Pavlović** (Matematički fakultet, Univerzitet u Beogradu)
  Tutorijal: Koherentna logika

  Apstrakt:
  U ovom izlaganju ćemo ukratko izložiti oblast koherentne logike (koja se ponekad naziva i "geometrijskom logikom") i njene osobine. U poslednjih petnaest godina korišćena je u nekoliko okruženja za dokazivanje teorema na tradicionalni način. Takodje ćemo diskutovati o tome kakva je veza dokazivača teorema koji mi razvijamo i koherentne logike, kao i ostalih sistema koji je koriste.

- **Saša Malkov** (Matematički fakultet, Univerzitet u Beogradu)
  Istraživanje korelacija izmedju aminokiselina i sekundarne strukture proteina

  Apstrakt:

Korelacija primarne i sekundarne strukture proteina je analizirana na osnovu podataka iz kolekcije Protein Data Bank (PDB). Izračunate su statističke korelacije izmedju svake od 20 aminokiselina i 8 tipova sekundarnih struktura, na medjusobnoj udaljenosti od 25 jedinica. Na osnovu dobijenih rezultata i skolonosti gradjenju odredjenih sekundarnih struktura, aminokiseline su klasifikovane u četiri grupe: sklone α-heliksima, sklone trakama, sklone zavojima i ostale (His i Cys ne pokazuju naklonost ni prema jednoj sekundarnoj strukturi). Pokazuje se da aminokiseline u istoj grupi imaju slične strukturne karakteristike na Cβ i Cγ atomima. Sve AK sklone α-heliksima nemaju ni polarne heteroatome vezane na atome Cβ i Cγ, ni grananje ni aromatične grupe na atomu Cβ. Sve AK sklone trakama imaju aromatične grupe ili heteroatome na atomu Cβ. Sve AK sklone zavojima imaju polarne heteroatome na atomima Cβ ili Cγ ili uopšte nemaju atom Cβ. Ova nova pravila mogu biti korisna u predvidjanju ponašanja sintetisanih AK koje ne postoje u prirodi. Rezultati udaljenih korelacija pokazuju značajnost korelacija na udaljenosti do 10 jedinica. Pokazuje se da delovi vezani na atome Cβ i Cγ imaju primarnu ulogu u sklonosti AK prema sekundarnim strukturama podataka na istom mestu, a da polarnost aminokiselina ima značajan uticaj na gradjenje α-heliksa i traka na udaljenim mestima u sekvenci. Korelacije koje odgovaraju polarnim AK su značajno asimetrične.

01.04.2009.

- **Damjan Krstajić** (Istraživački centar za hemijsku informatiku)
  Proces pronalaska leka i mogućnosti primene automatskog rezonovanja u tom procesu

  Apstrakt:
  Pronalazak leka je iterativan proces gde se radi na optimizaciji više ciljeva, na prvi pogled kontradiktornih. Proces će biti predstavljen u kratkim crtama i to pre svega matematičkim jezikom. Na kraju izlaganja će biti predstavljene početne ideje za moguću primenu automatskih rešavača. Cilj izlaganja je da se na kraju pokrene diskusija o mogućnostima primene automatskih rešavača u procesu pronalaska leka.

- **Filip Marić** (Matematički fakultet, Univerzitet u Beogradu)
  Primer primene SAT rešavača na parsiranje prirodnog jezika

  Apstrakt:
  U okviru ovog predavanja biće prikazana tehnika parsiranja prirodnog jezika zasnovana na korišćenju SAT rešavača. Parsiranje se zasniva na formalizmu "link-gramatika" – svakoj reči u rečenici, korišćenjem rečnika, pridružuje se skup veza koje ona može da ostvari sa ostalim rečima u rečenici i zadatak parsiranja je da se uspostave veze izmedju svih reči u rečenici tako da se ispoštuju odredjeni,

unapred zadati, uslovi. Pristup o kome će biti reči predstavlja sve uslove ovog tipa iskaznom formulom i koristi SAT rešavač kako bi pronašao njene modele. Pronadjeni modeli odgovaraju ispravnim povezivanjima, tj. sintaksnim stablima rečenice. Projekat je radjen tokom leta 2008. godine u okviru programa Google Summer of Code i očekuje se dalji rad na ovom projektu.

16.04.2009.

- **Srdjan Vesić** (Univerzitet Pol Sabatje, Tuluz)
  Apstraktni okvir za odlučivanje zasnovan na argumentima

  Apstrakt:
  U ovom radu predlažemo novi pristup za odlučivanje zasnovan na argumentima. Koristimo sistem za argumentaciju u Dungovom stilu koji na ulazu ima različite argumente u prilog mogućim opcijama, konflikte izmedju argumenata kao i preferencije medju njima a na izlazu daje status svake od opcija i kompletan poredak opcija. U drugom delu ovog rada predstavljamo jedan specijalan slučaj opšteg sistema, naime sistem koji odabira opciju koju podržava najjači argument, pod uslovom da taj argument preživljava sve napade ostalih argumenata. Potom izučavamo svojstva ovog sistema, sa posebnim naglaskom na to kako se menja status opcija (npr. prihvaćena opcija postaje odbijena) u svetlu novog argumenta.

- **Jasmina Lazić** (Univerzitet Brunel, Velika Britanija, Matematički institut SANU, Beograd)
  Metoda promenljivih okolina sa dekompozicijom za rešavanje problema 0-1 mešovitog celobrojnog programiranja

  Apstrakt:
  U ovom radu predstavljena je nova hibridna heuristika za rešavanje 0-1 mešovitog celobrojnog programiranja. Sistematično tvrdo fiksiranje promenljivih vrši se u skladu sa pravilima metode promenljivih okolina. Promenljive koje će biti fiksirane se biraju u zavisnosti od rastojanja njihovih vrednosti do vrednosti odgovarajućih promenljivih u rešenju linearne relaksacije polaznog problema. Ako se time postigne poboljšanje vrednosti funkcije cilja, metoda promenljivih okolina sa spustom se primenjuje kao lokalno pretraživanje u celom prostoru pretraživanja. Ovim pristupom poboljšano je 8 do sada najboljih poznatih rezultata za instance iz poznate klase od 29 vrlo teških problema mešovitog celobrojnog programiranja. Osim toga, eksperimenti su pokazali da ova metoda daje bolje rezultate od komercijanog CPLEX rešavača, kao i od još tri aktuelne najuspešnije metode.

29.04.2009.

- **Tihomir Gvero, Miloš Gligorić** (Elektrotehnički fakultet, Univerzitet u Beogradu)
  UDITA: Ujedinjene Deklarativne i Imperativne Test Apstrakcije

  Apstrakt:
  Test apstrakcije su opisi test problema na visokom nivou pomoću kojih alati mogu automatski da generišu konkretne skupove testova. Ranijim istraživanjima su razvijena dva odvojena pristupa za generisanje testova na osnovu 1) deklarativnih 2) imperativnih test apstrakcija. Ova dva pristupa pokazuju svoje dobre strane kroz različite test apstrakcije. Programeri su trenutno primorani da izaberu jedan od ova dva pristupa, što određene aspekte kompleksnih test apstrakcija čini teškim za opis ili neefikasnim za izvršavanje. Mi predstavljamo UDITA-u, novi radni okvir koji ujedinjuje deklarativne i imperativne test apstrakcije koristeći nedeterministička proširenja u Javi. Kako bi se postiglo efikasno generisanje testova, uvodimo ideju odloženog nedeterminističkog izbora u model checking-u, i razvijamo nove algoritme za odloženo generisanje povezanih struktura. Objašnjavamo implementaciju našeg pristupa u Java PathFinder-u (JPF), popularnom model checker-u za Java programe. Evaluirali smo našu tehniku generianjem testova za niz struktura podataka, za refactoring engine-e, i za sam JPF. Naši eksperimentalni rezultati pokazuju da je generisanje testova korišćenjem ovog pristupa praktično, vodeći ka apstrakcijama koje se lakše pišu i nudi brže generisanje nego u predhodnim radnim okvirima. Rezultati pokazuju da je naša optimizujuća tehnika odloženog izbora od velike važnosti za efikasno generisanje testova. Eksperimenti su otkrili nekoliko predhodno nepoznatih bagova u Eclipse-u, NetBeans-u, i JPF-u.

- **Predrag Janičić** (Matematički fakultet, Univerzitet u Beogradu)
  Korišćenje lema u algebarskim dokazivačima geometrijskih teorema

  Apstrakt:
  Postoji nekoliko veoma efikasnih algebarskih metoda za dokazivanje geometrijskih teorema i nekoliko pratećih implementacija. Međutim, nijedna od njih ne podržava korišćenje lema i proces dokazivanja uvek kreće iznova, bez oslanjanja na već stečeno znanje. U ovom izlaganju biće izložena jedna ideja za korišćenje lema i plan realizacije u okviru sistema GCLC.

13.05.2009.

- **Gordana Pavlović Lažetić, Nenad Mitić** (Matematički fakultet, Univerzitet u Beogradu)
  N-gramska karakterizacija i predikcija genomskih ostrva

  Apstrakt:
  Biće predstavljena nova, na n-gramima zasnovana metoda za analizu

segmenata u bakterijskim genomima poznatih kao genomska ostrava (GI). Identifikacija GI u bakterijskim genomima je veoma značajna jer mnoga od njih predstavljaju ubačene delove (inserte) koji doprinose bakterijskoj evoluciji i patogenezi. Karakterizacija GI je izvedena na osnovu raspodele n-gramskih frekvencija i zifovske (Zipf) analize prezastupljenih i podzastupljenih n-grama, identifikovanih statistikom baziranom na Markovljevom modelu maksimalnog reda. Metoda je primenjena na specifične regione genoma bakterije Escherichia coli O157:H7 EDL933. Ona profinjuje karakterizaciju zasnovanu na drugim kompozicionim svojstvima genoma kao što su G+C sadržaj ili korišćenje kodona.

N-gramska karakterizacija GI poslužila je kao osnov za metodu predikcije GI. Sastoji se u kombinovanju n-gramskih raspodela operatorima unije i preseka uz definisanje dve mere za ocenu rezultata - odziva (recall) i preciznosti (precision). Korišćenjem najboljih kriterijuma (kombinacija), dobijenih obučavanjem na soju Escherichia coli O157:H7 EDL933, izvršeno je predviđanje GI u 14 genoima familije Enterobacteriaceae i u 21 genomu slučajno odabranih bakterija. Predviđanja su upoređena sa rezultatima dobijenim iz dve posojeće baze genomskih i patogenih ostrva. Rezultati pokazuju da primena n-grama poboljšava i preciznost i odziv predviđanja.

Biće ukratko predstavljen i prethodni rad autora u oblasti bioinformatike, kao i neka tekuća istraživanja.

27.05.2009.

- **Filip Marić** (Matematički fakultet, Univerzitet u Beogradu)
  Refaktorisanje - poboljšanje dizajna postojećeg koda

  Apstrakt:
  Refaktorisanje je proces menjanja softverskog sistema tako da se ne menja njegovo spoljno ponašanje, već se poboljšava unutrašnja struktura koda. Na ovom predavanju će (kroz jednostavniji primer u programskom jeziku JAVA) biti prikazane osnovne ideje i tehnike sistematskog refaktorisanja. Takodje, biće prikazana tehnika testiranja funkcionalnih jedinica sistema (unit testing) i biće nagoveštena upotreba projektnih obrazaca (design patterns) kao "gotovih rešenja" za određene probleme softverskog dizajna.

17.06.2009.

- **Julien Narboux** (Univerzitet "Louis Pasteur", Strazbur)
  Formalization and automation of geometric reasoning within the Coq proof assistant

  Apstrakt:
  I will present my work about the formalization and automation of

geometric reasoning within the Coq proof assistant. In the first part, I will present a mechanization of the geometry of Tarski. This consists in the formalization of the first eight chapters of the book of Schwabäuser, Szmielew and Tarski: Metamathematische Methoden in der Geometrie. I will explain our approach to deal with degenerated cases using ranks in the context of projective geometry. In the second part, I will present my implementation in Coq of a decision procedure for affine plane geometry: the area method of Chou, Gao and Zhang. This method produces short and readable proofs. In the last part, I will we propose a diagrammatic formal system to perform proofs in the field of abstract term rewriting. For instance, using this system we can formalize the diagrammatic proof of the Newman's lemma. The system is proved correct and complete for a class of formulas called the coherent logic.

ARGO seminar 2008/2009

Milan Banković

28.06.2009.

Argo seminar is a regular seminar of the Argo group. Main fields discussed are Automated Reasoning and Applications, Theoretical Computer Science, Artificial Intelligence and Data Mining. The seminar is dedicated mainly to PhD students in Computer Science. One meeting typically consists of two lectures: a tutorial one (where known results on one specific topic are presented) and a research one (where original research work is presented).

Meetings take place once in two weeks, usually on Wednesday at 5:15PM, in the premises of the Faculty of Mathematics in Jagićeva street.

Argo seminar has started in academic year 2007/08.

The seminar's leader is Predrag Janičić, and a seminar's secretary is Vesna Pavlović.

1 Given talks

05.11.2008.

- **Vesna Pavlović** (The Faculty of Mathematics, University of Belgrade)
  ICCL Summer school 2008, Dresden - trip report

  Abstract:
  Sixth ICCL summer school was held in Dresden from 24. August until 6. September and it was organized by TU Dresden. The main topic was the relationship between modern formal logic and common sense which characterize human reasoning. In this lecture the main ideas from this summer school will be presented in short.

- **Damjan Krstajić** (Research Centre for Cheminformatics)
  Discovery Bus - a system for automating QSAR modelling

  Abstract:
  There are many different methods and approaches to solve QSAR/statistical modelling problems. Regardless of our preference to a set of techniques, practice teaches us that there is no single bullet proof way to solve QSAR problems. On the other hand, in the age of highly automated laboratories there is a bombardment of new data and experimental results. The challenge is to design a system that will cope with constant influx of new information and to automate QSAR modelling without sacrificing the quality

of predictions. Discovery Bus is our solution to the challenge. It is an implementation of Competitive Workflow, a novel software architecture, implemented using autonomous software agents.

19.11.2008.

- **Mladen Nikolić** (The Faculty of Mathematics, University of Belgrade)
  Tutorial: Linear regression and its application in SAT solver improvement

  Abstract:
  Regression is a way of estimating a function that approximately defines a relationship between two random variables. Usually such a function is determined by a set of parameters for which suitable values should be chosen. The choice is made based on given training data. If all feasible functions are linear in its parameters regression is called linear. This problem is usually solved by minimization of mean squared error using the method of the least squares with optional problem regularization. One application of linear regression is prediction of solving time for discrete problems like SAT based on characteristics of problem instance.

- **Milan Banković** (The Faculty of Mathematics, University of Belgrade)
  The `alldifferent` *SMT solver*

  Abstract:
  Constraint programming is research area with growing importance in recent years due to its flexibility and broad application area. It is declarative programming style in which problem is defined by set of constraints the problem's solution must satisfy. To solve this kind of problem means finding values of variables that satisfy all the problem's constraints. One of the best known and the most common constraints is `alldifferent` constraint which restricts every two different variables in given set of variables not to take equal values. Special challenge is relating constraint programming to SAT problem, using SMT approach. In this talk, we will give a short overview of `alldifferent` constraint, relating it to the matching theory in bipartite graphs. We will establish relation between `alldifferent` constraint and SAT problem by representing `alldifferent` constraint as a SMT problem. Finally, we will propose an algorithm for generating explanations of theory propagations in the `alldifferent` SMT solver.

03.12.2008.

- **Predrag Janičić** (The Faculty of Mathematics, University of Belgrade)

Visit to University of Rome and presentation of the GCLC package

Abstract:
In this talk, a recent visit to the Department of Mathematics at the University of Rome will be discussed. Two lectures on GCLC given there will be briefly repeated. Special attention will be given to possible directions for further improvements of GCLC.

- **Panel discussion** ()
Current research issues

Abstract:
Discussion on current and planned research problems, especially about aspects relevant for new postgraduate students.

24.12.2008.

- **Staša Vujičić** (The Faculty of Mathematics, University of Belgrade)
Tutorial: Genetic algorithms

Abstract:
Genetic algorithms provide an approach to learning that is based on simulated evolution. Hypotheses are often described by bit strings whose interpretation depends on the application, though hypotheses may also be described by symbolic expressions or even computer programs. The search for an appropriate hypothesis begins with a population, or collection, of initial hypotheses. Members of the current population give rise to the next generation population by means of operations such as random mutation and crossover, which are patterned after processes in biological evolution. At each step, the hypotheses in the current population are evaluated relative to a given measure of fitness, with the most fit hypotheses selected probabilistically as seeds for producing the next generation. Genetic algorithms have been applied successfully to a variety of learning tasks and to other optimization problems. For example, they have been used to learn collections of rules for robot control and to optimize the topology and learning parameters for artificial neural networks. This paper covers both genetic algorithms, in which hypotheses are typically described by bit strings, and genetic programming, in which hypotheses are described by computer programs.

- **Bojan Marinković** (Mathematical Institute of the Serbian Academy of Science and Arts)
A Logic with a Conditional Probability Operator

Abstract:
In August 2008, summer school ESSLLI 2008 took place at Hamburg. Group of young researchers of the Mathematical

Institute of the Serbian Academy of Science and Arts presented their paper during student session of ESSLLI. In this talk, that paper is going to be presented. It presents a sound and strongly complete axiomatization of the reasoning about linear combinations of conditional probabilities and decidability with a PSPACE containment for the decision procedure. Also, the information on ESSLLI summer school is going to be given.

25.02.2009.

- **Aljoša Obuljen** (The Faculty of Mathematics, University of Belgrade)
  Tutorial: Bayesian learning

  Abstract:
  This article represents a brief overview of Bayesian learning. Bayesian approach to machine learning is appropriate when data analysis and decision making should be done based on probability theory. This approach is important both for using probability theory to determine relevance of data in favor of some hypothesis, as well as to analyze and compare other methods of machine learning.

- **Predrag Janičić** (The Faculty of Mathematics, University of Belgrade)
  Uniform reduction of hard problems to SAT

  Abstract:
  In this talk, a uniform approach for reducing hard problems to SAT will be presented. The approach uses the idea of operator overloading in object-oriented programming. The approach has already been applied to cryptoanalitical problems (joint work with Dejan Jovanović and Milan Šešum). It will be described how additional types of problems, with a special emphasis on NP-complete problems, can be addressed in a similar same way.

18.03.2009.

- **Sana Stojanović, Vesna Pavlović** (The Faculty of Mathematics, University of Belgrade)
  Tutorial: Coherent Logic

  Abstract:
  In this talk we will briefly present coherent logic (sometimes referred to as "geometry logic") and its properties. Over the last fifteen years it has been used in several frameworks for proving geometrical theorems in traditional way. We will also discuss how the theorem prover that we are developing relates to coherent logic and other systems that use it.

- **Saša Malkov** (The Faculty of Mathematics, University of Belgrade)
  A Reexamination of Correlations of Amino Acids with Particular Secondary Structures

  Abstract:
  The correlations of primary and secondary structures of proteins were analyzed using a data set from the Protein Data Bank. The correlation values of the amino acids and the eight secondary structure types were calculated, where the position of the amino acid and the position in sequence with the particular secondary structure differ at most 25. Clear preferences of amino acids towards certain secondary structures classify amino acids into four groups: α-helix preferrers, strand preferrers, turn and bend preferrers, and His and Cys (the latter two amino acids do not show clear preference for any secondary structure). Amino acids in the same group have similar structural characteristics at their Cβ and γ atoms that predicts their preference for a particular secondary structure. All α-helix preferrers have neither polar heteroatoms on Cβ and γ atoms nor, branching nor aromatic group on the Cβ atom. All strand preferrers have aromatic groups or branching on the Cβ atom. All turn and bend preferrers have polar heteroatom on Cβ or γ atoms or do not have a Cβ atom at all. These new rules can be helpful in making predictions about non-natural amino acids. The results show that the substituents on Cβ or γ atoms of amino acid play major role in their preference for particular secondary structure at the same position in the sequence, while the polarity of amino acid has significant influence on α-helices and strands at some distance in the sequence. The diagrams corresponding to polar amino acids are noticeably asymmetric.

01.04.2009.

- **Damjan Krstajić** (Research Centre for Cheminformatics)
  The process of drug discovery and possibilities of application of automated reasoning in that process

  Abstract:
  The process of drug discovery is an iterative process which can be seen as a multi-objective optimisation. The simple layout of the process will be presented using mainly mathematical terms. Some ideas regarding the implementation of SAT solvers in this field will be presented. The aim of the presentation is to start a discussion on possibilites of implementing SAT solvers in drug discovery.

- **Filip Marić** (The Faculty of Mathematics, University of Belgrade)
  An Example of Natural Language Parsing by reduction to SAT

  Abstract:
  This lecture will present a method of parsing natural language by

using a SAT solver. Parsing is based on the "link grammar" formalism – to each lecture in a sentence a number of possible connectors is assigned (based on its dictionary description) and the task is to connect all the words in a sentence and form a linkage which satisfies some predetermined citeria. The approach that is going to be presented encodes the linking constraints by a SAT formula and uses a SAT solver to construct its models. Models correspond to valid linkages, i.e., to the correct parses of the sentence. This project was a part of Google Summer of Code in 2008., and further work on this project is expected.

16.04.2009.

- **Srdjan Vesić** (Paul Sabatier University, Toulouse)
  An abstract argumentation framework for decision making

  Abstract:
  In this work, we propose a novel approach for argumentation-based decision making. We suggest a Dung style general argumentation framework that takes as input different arguments, defeat and preference relations among them, and returns as outputs a status for each option, and a total preordering on a set of options. We study a particular class of this general framework, the one that privileges the option that is supported by the strongest argument, provided that this argument survives to the attacks. The properties of the system are investigated, and the revision of the status of a given option in light of a new argument is studied.

- **Jasmina Lazić** (Brunel University, UK, Mathematical Institute of SASA, Belgrade)
  Variable Neighbourhood Decomposition Search for 0-1 Mixed Integer Programs

  Abstract:
  In this paper we propose a new hybrid heuristic for solving 0-1 mixed integer programs based on the variable neighbourhood decomposition search principle. It combines variable neighbourhood search with general-purpose CPLEX MIP solver. We perform systematic hard variables fixing (or diving) following the variable neighbourhood search rules. Variables to be fixed are chosen according to their distance from the corresponding linear relaxation solution values. If there is an improvement, variable neighbourhood descent branching is performed as the local search in the whole solution space. Numerical experiments have proven that by exploiting boundary effects in this way, solution quality can be considerably improved. With our approach, we have managed to improve the best known published results for 8 out of 29 instances from a well-known class of very difficult MIP problems. Moreover, computational results show that our method outperforms CPLEX MIP solver, as well as three

other recent most successful MIP solution methods.

29.04.2009.

- **Tihomir Gvero, Miloš Gligorić** (The Faculty of Electrical Engineering, University of Belgrade)
  UDITA: Unified Declarative & Imperative Test Abstractions

  Abstract:
  Test abstractions are high-level descriptions of testing problems from which tools can automatically generate a concrete set of tests. Previous research has developed separate approaches for generating tests from 1) declarative and 2) imperative test abstractions. These two approaches show their strengths in different kinds of test abstractions. Developers are currently forced to choose one of these approaches, making certain aspects of complex test abstraction awkward to describe or inefficient to execute. This paper presents UDITA, a new framework that unifies both declarative and imperative test abstractions using a non-deterministic Java extension. To make test generation using this approach efficient, we leverage the ideas of delayed non deterministic choice in model checking, and develop new algorithms for delayed generation of linked structures. We describe an implementation of our approach in Java PathFinder (JPF), a popular model checker for Java programs. We evaluate our technique by generating tests for a number of data structures, for refactoring engines, and for JPF itself. Our experimental results show that test generation using this approach is practical, leading to test abstractions that can be easier to write and offer faster generation than in previous frameworks. The results show our delayed optimization technique to be essential for making test generation feasible. The experiments revealed several previously unknown bugs in Eclipse, NetBeans, and JPF.

- **Predrag Janičić** (The Faculty of Mathematics, University of Belgrade)
  Using lemmas in algebraic methods for geometry theorem proving

  Abstract:
  There are several very efficient algebraic methods for geometry theorem proving and several implementations of these methods. However, none of them address the problem of lemma invocation and the proving process always starts from a scratch, without using knowledge built so far. In this talk, one idea for using lemmas and a plan how to incorporate it in the system GCLC will be discussed.

13.05.2009.

- **Gordana Pavlović Lažetić, Nenad Mitić** (The Faculty of Mathematics, University of Belgrade)

n-Gram characterization and prediction of genomic islands

Abstract:
A novel, n-gram-based method for analysis of bacterial genome segments known as genomic islands (GIs) will be presented. Identification of GIs in bacterial genomes is an important task since many of them represent inserts that may contribute to bacterial evolution and pathogenesis. Characterization of GIs is performed by n-gram frequency distribution and a Zipf-like analysis of overrepresented and underrepresented n-grams identified by a statistic based on the maximal order Markov model. The method is applied to strain-specific regions in the Escherichia coli O157:H7 EDL933 genome. It refines a characterization based on other compositional features such as G+C content and codon usage.

N-gram-based characterization of GIs gave rise to a method for GIs' prediction. N-gram distributions were combined by union and intersection and two measures defined for evaluating the results - recall and precision. Using the best criteria (by training on the Escherichia coli O157:H7 EDL933 genome), GIs were predicted for 14 Enterobacteriaceae family members and for 21 randomly selected bacterial genomes. These predictions were compared with results obtained from two existing databases of genomic and pathogenecity islands. The results obtained show that application of n-grams improves both relative precision and recall.

The presentation will skim the authors' previous work in bioinformatics, as well as their ongoing research.

27.05.2009.

- **Filip Marić** (The Faculty of Mathematics, University of Belgrade)
  Refactoring - improving the design of existing code

  Abstract:
  Refactoring is the process of changing a software system so that its outer functionality is not affected, but only the inner structure of the code is improved. This talk will (through a simple JAVA example) demonstrate the techniques of systematic code refactoring. Also, unit testing will be described and the idea of using design patterns as a form of "of the shelf solutions"for some software design problems will be introduced.

17.06.2009.

- **Julien Narboux** (University Louis Pasteur, Strasbourg)
  Formalization and automation of geometric reasoning within the Coq proof assistant

  Abstract:

I will present my work about the formalization and automation of geometric reasoning within the Coq proof assistant. In the first part, I will present a mechanization of the geometry of Tarski. This consists in the formalization of the first eight chapters of the book of Schwabäuser, Szmielew and Tarski: Metamathematische Methoden in der Geometrie. I will explain our approach to deal with degenerated cases using ranks in the context of projective geometry. In the second part, I will present my implementation in Coq of a decision procedure for affine plane geometry: the area method of Chou, Gao and Zhang. This method produces short and readable proofs. In the last part, I will we propose a diagrammatic formal system to perform proofs in the field of abstract term rewriting. For instance, using this system we can formalize the diagrammatic proof of the Newman's lemma. The system is proved correct and complete for a class of formulas called the coherent logic.

CADGME 2009, Hagenberg, July 2009

Predrag Janičić

26.08.2009.

1 Introduction

I participated at the conference CADGME (Conference on Algebra and Dynamic Geometry in Mathematical Education) held in Hagenberg, Austria from July 11 to July 13, 2009. The conference gathered together around 90 educators (at high-school and university level), researchers, and developers of mathematical software. Actually, my impression was that the participants could have been divided into three categories: educators, researchers and developers of mathematical tools focused on applicability of their tools in education, and those that actually do not think too hard about educational aspects and leave it to others. The schedule was rather dense and sometimes not well distributed to the four tracks, so one would be forced to choose between talks that are related and should be in a single track. Many talks were on applications of mathematical software in education, and many of them were focused on applications of GeoGebra. Regarding the GeoGebra tool, an interesting new knowledge for me was that it has made huge popularity and I think now it beats all other dynamic geometry tools, including commercial ones. The satellite workshop on GeoGebra proved this fact by attracting maybe even more people than the main conference. I think this success is due to the following reasons: it is open-source, apart from geometry it also deals (to some extent) with algebra, it is simple, there are many available resources, it is focused on real applications in classroom and is strongly influenced by educators who use it. And last, but not least, the fact that it is getting so popular attracts even more new users.

2 People

While there were some very interesting talks (e.g., the invited talk about mathematical inventions given by Bruno Buchberger), the most important gain for me was an opportunity to meet a number of people developing mathematical software and to discuss various issues with them.

Concerning researchers/developers of geometry tools, these are some of the people present: Ulrich Kortenkamp and Jürgen Richter-Gebert (from Germany, the authors of Cinderella), Markus Hohenwarter (the main author of GeoGebra), Francisco Botana from Spain (the author of the tool Discovery, based on algebraic theorem proving), Tomas Recio from Spain (also working on algebraic proving and discovery), etc.

I had interesting discussions with them both on specific issues in geometry software and in possibilities for collaboration. I learnt there is an ongoing

Slika 1: The castle of Hagenberg, the home of RISC

European project (ending in 2010) in the domain of dynamic geometry InterGeo (`http://i2geo.net`). It links several European groups and individuals and it is good to have links with it.

During the conference there was a discussion on linking automated theorem proving and dynamic geometry and that discussion later continued by email and involved several people. It might lead to some collaboration (probably in adding automated theorem proving features to GeoGebra).

I spent a lot of time together also with Walther Neuper (Austria) and Ralph-Johan Back (Finland, the inventor of refinement calculus, among other things). I enjoyed discussions with them, ranging from mathematical education and formal methods, to history and other stuff not related to our work.

3 My Talk

My talk was titled "Automated Geometry Theorem Proving: Readability vs. Efficiency". My main message was that we could try to improve readability of proofs generated by algebraic and semi-algebraic theorem provers by using lemmas and, on the other hand, that we could try to improve efficiency of methods that produce traditional proofs by adding to them features of modern provers from other areas (e.g., adding the SAT technique backjumping to a theorem prover based on coherent logic). After my talk there several questions, but unfortunately I recorder only three of them.

Q (Ralph-Johan Back, Finland): You said you want to generate readable proofs. If a conjecture was shown to be valid, why would one need a readable proof? What is your audience for these readable proofs?

A: One audience are educators and students. If you want to show them that something is valid, it is good if you can show them a readable proof. The second audience comes from the field of mathematical knowledge management. It is

good to have (to generate and store) proofs that look like proofs in standard textbooks.

Q (Lituania): Proofs that generate machine theorem provers could be longer than proofs produces by a human?

A: Of course. But in some cases it could be the opposite. In addition, before a theorem prover present a proof to the user, it can optimize it, i.e., delete, all non needed parts.

Q (Djordje Herceg, Serbia): Could a computer give some guidelines to the user while he tries to prove a theorem?

A: It is possible. There are tools that can *discover* new facts and that could be used as a guideline to the user. Francisko Botana who is here works in that direction.

Slika 2: A view from the castle of Hagenberg

4 Hagenberg

Hagenberg is a little village some 30km away from Linz. Some thirty years ago, the castle was reconstructed and became a home of RISC (Research Institute for Symbolic Computation), with Bruno Buchberger (the inventor of the theory of Gröbner bases) as its most prominent figure from its first days.

Nowadays, Hagenberg is the site of a number of software companies and it is probably the most important center for information technologies in Austria. Within the šoftware park"there is also a hotel (or rather a student hostel) for people visiting the institute and the companies. However, Hagenberg is still small and rather quite place with two pubs, one bakery, one more shop and one post office. The surrounding is beautiful — hilly and green. All in all, a perfect place for doing research.

Research visit to Universitat Politecnica de Valencia, Spain, May – July 2009

Vesna Pavlović

06.09.2009.

From May 1^{st} 2009 until July 28^{th} 2009 I was staying in Valencia, Spain within Tempus DEUKS project as a visiting researcher. I was working in ELP (Extensions of Logic Programming) group at the Universitat Politecnica de Valencia, under supervision of prof. Salvador Lucas.

Slika 1: Departamento de Sistemas Informaticos y Computacion, Universitat Politecnica de Valencia

1 My work

Symbolic constraints that arise in proofs of termination are often translated into numeric constraints before checking them for satisfiability. Polynomial interpretations are a simple and popular choice for doing this. Elementary functions, where not only addition and product but also exponential, fractional, and trigonometric expressions are allowed, provide a natural extension of polynomial functions. In the nineties, Lescanne introduced the elementary interpretations as an alternative to polynomial interpretations in proofs of termination of term rewriting. Unfortunately, he did not consider the automatic generation of such interpretations for a given termination problem, which was an important drawback for using them in practice. Lucas solved this problem

by using a combination of rewriting, CLP, and CSP techniques for handling the elementary constraints which are obtained when giving the symbols parametric elementary interpretations. He proposed new rule - based transformation system for checking and solving (parametric) elementary constraints and my task was to modify it in a way to have its termination guaranteed.

My work there consisted from two parts:

- a theoretical part - I was learning basics of Term Rewriting Systems. An emphasize was on methods that use linear elementary interpretations for proving termination. The main problem I worked on was an automatic generation of such interpretations for a given termination problem. In this context I was improving a system for transformation of elementary constraints (done previously by prof. Lucas) in such a way to guarantee its termination.

- a practical study - after constructing a transformation system which, to our intuition, seemed to work correctly, we wanted to try it in practice and I was given a task to write a program in Prolog which would simulate the process of transforming a set of elementary constraints.

There is still some work left to be done (concerning implementation of the system as a whole). The research area itself seems very fruitful and inspiring, offering many ideas that can be formulated as separate research problems. We plan to finish the work we started, and maybe in the future to work on some problems related to this one.

2 Collaboration with ELP group

Slika 2: ELP group

Working within ELP group at the Universitat Politecnica de Valencia was a real pleasure for me. I was very warmly accepted and had a very good

communication with all the group members. The people from my office were most friendly and forthcoming and their experience in project area was truly helpful. They were also trying to make my stay at the university, as well as the stay in Spain at all, very pleasant and filled. Prof. Salvador Lucas was interested to discuss all the ideas with me, and was on disposal for all the problems and doubts I ran into during my stay there.

3 Valencia

The city of Valencia was a really great place to live during these three months. Once you are there you would never guess that you are in the third largest city in Spain, because there is no daily rush, not so much traffic and not too many tourists.

The city itself has so much to offer. The Turia gardens, placed in the old river bed of Turia river, made a great impression to me. After many years of fighting with floods that were damaging the city it was decided in 1960 to drain the water from the river and nowadays the river bed is full with nice gardens that surrounds the old historical center. Although the center itself is not that big, it has nice forums with beautiful fountains, many old churches and important buildings. If you want to enjoy the beach you would need about half an hour by foot to reach it. The must see in Valencia is the City of Arts and Sciences located at the end of the Turia gardens. At this moment it contains five buildings: the Oceanografico (as they say the largest aquarium in Europe), the Principe Felipe Science Museum (interactive science museum), the Hemisferic (eye - shaped cinema and planetarium), the Umbracle (a promenade) and the Palau de les Arts Reina Sofía (opera house).

Slika 3: City of Arts and Sciences

One of the things typical for Spain are flamenco performances. Flamenco group consists from guitar players, singers and dancers, and singing technique

reminds on crying. You can find some smaller flamenco groups performing in local cafes in the evening. The other traditional event is bullfighting (locally called corrida de toros). Everything in Spain starts late, the lunch, the dinner and the nightlife.

The prices in Valencia are not too high. I was having lunch with my group members in the university mensa for 4-5 euros. You can have a nice dinner in some of the local restaurants for 10 Euros. The local specialties are paella (made in many different ways) and horchata (traditional Valencian drink). The prices of the food in supermarket are more - less the same as in Serbia (maybe even lower).

I was renting a room with private bathroom for 300 Euros per month (the flat was very well located, 15 minutes by foot to the Univeristy, 20 minutes to the city center). The city has a good subway system (which includes also trams) and a card for 10 rides costs 7 Euros. The same ticket for the bus transport costs more less the same. However, I enjoyed walking in Valencia and I was using a public transport only in rare occasions.

The city has also a very good position. It takes four hours to reach Madrid, and also Barcelona, by bus. The price of the bus ticket for round trip for these destinations was round 60 Euros.

There is no direct flight from Serbia to Valencia, so I traveled via Munich. I traveled with Lufthansa/SpainAir and the ticket was 450 Euros.

ARGO seminar 2009/2010

Vesna Pavlović

04.10.2010.

Argo seminar je seminar Argo grupe. Bavi se uglavnom, ali ne isključivo, automatskim rezonovanjem i primenama, teorijskim računarstvom, veštačkom inteligencijom i data-mining-om. Seminar je posvećen uglavnom studentima poslediplomcima. U principu, prvi deo seminara je tutorijalski, u drugom se izlažu istraživački problemi.

Sastanci se održavaju jednom u dve nedelje, uglavnom sredom u 17h u prostorijama Matematičkog fakulteta u Jagićevoj ulici.

Argo seminar se održava od akademske godine 2007/08.

Rukovodilac seminara je Predrag Janičić, a sekretar seminara Vesna Pavlović.

1 Održana predavanja

4.11.2009.

- **Filip Marić** (Matematički fakultet, Univerzitet u Beogradu)
  Izveštaj o ucešću na konferencijama SAT2009 i TPHOLs2009

  Apstrakt:
  U izlaganju će biti prikazani najznačajniji utisci sa poseta konferencijama SAT2009 (Swansea, Velika Britanija) i TPHOLs2009 (Munich, Nemacka). Konferencija SAT je posvećena teoriji i primenama ispitivanja zadovoljivosti dok je konferencija TPHOLs posvećena najnovijim trendovima u interaktivnom dokazivanju teorema.

- **Mladen Nikolić** (Matematički fakultet, Univerzitet u Beogradu)
  Osnove geostatistike

  Apstrakt:
  Geostatistika pretstavlja podskup statistike specijalizovan za analizu i interpretaciju prostornih podataka. U ovom izlaganju biće prikazana osnovna predikciona metoda koja ima široke primene u geostatistici. Pored toga, biće pokazano kako se geostatistička analiza može vršiti kombinacijom alata kao sto su R i Google Earth umesto skupim komercijalnim softverima.

18.11.2009.

- **Vesna Pavlović** (Matematički fakultet, Univerzitet u Beogradu)
  Izveštaj o boravku na Politehničkom univerzitetu u Valensiji

  Apstrakt:
  U okviru Tempus DEUKS projekta u periodu od 01.05 do 28.07. boravila sam na Politehničkom Univerzitetu u Valensiji, Španija, kao gostujući istraživač. Glavna tema mog rada bila je automatsko generisanje linearnih elementarnih interpretacija za dokazivanje zaustavljanja datog sistema za prezapisivanje termova. Na ovom predavanju biće ukratko izložene osnove sistema za prezapisivanje termova, metode koje se koriste za dokazivanje njihovog zaustavljanja, sa osvrtom na konkretan problem na kome sam radila.

- **Ivana Tanasijević** (Matematički fakultet, Univerzitet u Beogradu)
  Predstavljanje prostora i prostorno rezonovanje

  Apstrakt:
  Potreba za prostornom reprezentacijom i rezonovanjem je zauzela posebno mesto u mnogim sferama Vestačke inteligencije. U ovom izlaganju je dat pregled osnovnih pojmova, pri čemu je naglasak na kvalitativnoj reprezentaciji i problemima prostornog rezonovanja. Kako se ovi problemi mogu svesti na problem konzistentnosti, to će ovde biti reči o pristupu tom konkretnom problemu.

03.12.2009.

- **Bojan Marinković** (Matematički institut SANU)
  Gostovanje u okviru DEUKS projekta: O povezivanju heterogenih "overlay" mreža

  Apstrakt:
  Od 27. februara do 25. maja ove godine boravio sam u Sofii Antipolis u Francuskoj. Tokom ovog perioda radio sam u sastavu LogNet tima istraživačkog centra INRIA Sofia Antipolis - Mediteran, a pod mentorstvom profesora Luidjija Likvorija, šefa tima. Ovo je bila prilika da udjem u, za mene, novu oblast istraživanja - distribuirani sistemi. Glavni cilj mog rada je bila implementacija softvera prema algoritmu opisanom u radu "L. Liquori, C. Tedeschi, and F. Bongiovanni: BabelChord: a Social Tower of DHT-Based Overlay Networks. In 14th Symposium on Computers and Communications (ISCC 2009). IEEE, 2009. Short paper." Tokom ovog izlaganja biće izloženi osnovni koncepti "overlay" mreža, distribuiranih sistema, kao i "chord" i "babelchord" protokola.

- **Aljoša Obuljen** (Matematički fakultet, Univerzitet u Beogradu)
  Metoda za poravnanje na nivou reči zasnovana na dvojezičnom korpusu poravnatom na nivou rečenice

Apstrakt:
Automatsko poravnanje na nivou reči je jedan od ključnih problema u statističkom pristupu mašinskom prevodjenju. Razni metodi su do sada predlagani, sa različitim rezultatima. U ovom radu, predlažemo jednostavnu metodu rangiranja sa primenom na poravnanje na nivou reči, ako je dat dvojezički korpus poravnat na nivou rečenice. Ova metoda se takodje može primeniti i na korpuse poravnate na drugim nivoima, kao što je nivo pasusa ili čak većeg segmenta teksta, ako je količina poravnatog teksta dovoljno velika. Drugim rečima, metoda je robustna u odnosu na granularnost poravnanja. Za potrebe ovog rada, poravnanje na nivou rečenice je odabrano, kao standardno poravnanje u statističkom mašinskom prevodjenju. Dvojezični korpus umerene veličine (oko 1M reči/tokena po jeziku) je korišćen radi dobijanja rezultata - poravnat srpsko-engleski korpus tekstova vezanih za obrazovanje, ekonomiju, zdravstvo i zakonodavstvo (SELFEH - Serbian-English Law Finance Education and Health), jedan od brojnih resursa razvijenih u okviru HLT grupe pri Univerzitetu u Beogradu.

30.12.2009.

- **Mladen Nikolić** (Matematički fakultet, Univerzitet u Beogradu)
  Metodologija poredjenja SAT rešavaca

  Apstrakt:
  Odmeravanje poboljšanja modernih SAT rešavača, ili poredjenje dva proizvoljna rešavača je težak, ali važan zadatak. Rešavači se obično porede njihovim izvršavanjem na nekom skupu iskaznih formula i poredjenjem broja rešenih formula ili njihovih vremena izvršavanja na neki jednostavan način. Biće izložena nova, statistički zasnovana, metodologija njihovog poredjenja.

- **Mirko Stojadinović** (Matematički fakultet, Univerzitet u Beogradu)
  Kvalitetan istraživački rad, objavljivanje radova u časopisima i sposobnost dobrog organizovanja

  Apstrakt:
  U izlaganju će biti ukratko izloženi ključni problemi pri istraživanju, pisanju i objavljivanju radova, veštine prezentovanja i dobre organizacije, kao i način pisanja predloga za projekte. Biće napravljena i kratka paralela izmedju mentorstva i post-diplomskih studija u Srbiji i Velikoj Britaniji. O svemu tome sam slušao na predavanjima organizovanim pri Ministarstvu za Nauku i Tehnološki razvoj koje je držao profesor Stiv Kvori (Steve Quarrie). Profesor Kvori ima dugogodišnje iskustvo u pisanju i objavljivanju radova, a radi i kao recenzent u više medjunarodnih časopisa.

31.03.2010.

- **Djordje Stakić** (Matematički fakultet, Univerzitet u Beogradu)
  Mašinsko učenje zasnovano na instancama

  Apstrakt:
  U izlaganju će biti predstavljeni metodi mašinskog učenja zasnovanog na instancama. Ovi metodi ne formiraju hipotezu unapred samo na osnovu trening primera, nego tek kada dobiju upitnu instancu na osnovu trening primera vrše njenu klasifikaciju. Značajniji predstavnici ovih metoda su metod k najbližih suseda, lokalna linearna regresija pomoću težina, radijalne baze funkcija i rezonovanje po slučajevima.

- **Predrag Janičić, Sana Stojanović, Vesna Pavlović, Mladen Nikolić** (Matematički fakultet, Univerzitet u Beogradu)
  Ideje o razvoju novog dokazivača teorema za koherentnu logiku

  Apstrakt:
  U izlaganju će biti ukratko opisani postojeći dokazivači teorema za koherentnu logiku - fragment logike prvog reda u kome se mogu izraziti različite značajne teorije. Jedna varijanta dokazivača je već razvijena u okviru ARGO grupe i testirana na teoremama iz oblasti geometrije. On se zasniva na pristupu koji se naziva 'forward chaining' i koji predstavlja dobru osnovu za generisanje čitljivih dokaza. Ipak, ovaj pristup nije dovoljno moćan za dokazivanje teških teorema. Biće diskutovano kako se pomenuti pristup može proširiti tehnikama iz drugih domena (npr. iz SAT rešavanja) koje bi mogle da značajno ubrzaju pretragu i kako se te tehnike mogu prilagoditi dokazivanju u koherentnoj logici.

14.04.2010.

- **Milan Banković** (Matematički fakultet, Univerzitet u Beogradu)
  SMT tutorijal

  Apstrakt:
  Problem zadovoljivosti u teoriji (SMT) je problem odlučivanja da li za datu formulu A prvog reda postoji model date teorije T takav da zadovoljava formulu A. Rešavanje SMT problema za različite teorije nalazi primenu u mnogim oblastima od verifikacije softvera i hardvera, preko problema rasporedjivanja do raznih optimizacionih problema. U ovom izlaganju biće dat opšti pregled SMT problema i njihovog rešavanja. Najpre će biti dat kratak teorijski uvod. Zatim će biti diskutovane neke teorije prvog reda koje se često javljaju u SMT rešavanju. Biće izloženi principi rada modernih SMT rešavača i njihova veza sa SAT rešavanjem. Na kraju će biti dat kratak osvrt na dosadašnji, tekući i budući rad Argo grupe u oblasti SMT rešavača.

- **Mladen Nikolić** (Matematički fakultet, Univerzitet u Beogradu)
  Neki detalji primenjene statistike

  Apstrakt:
  U ovom izlaganju, biće diskutovani pojmovi kao sto su p-vrednost i veličina efekta pri statističkom testiranju hipoteza, kao i njihova uloga u praksi. Biće prikazano nekoliko mera veličine efekta zasnovanih na korelaciji. Takodje će biti diskutovana razlika izmedju frekventističkog i Bajesovskog pristupa verovatnoći i statistici.

12.05.2010.

- **Predrag Janičić** (Matematički fakultet, Univerzitet u Beogradu)
  Neke novosti iz oblasti geometrijskog rezonovanja i dinamičke geometrije

  Apstrakt:
  U izlaganju će biti reči o nekim aktivnostima u vezi sa geometrijskim rezonovanjem i dinamičkom geometrijom: o konferencijama CADGME (Hagenberg, juli 2009) i AD+GG (Castro Urdiales, februar 2010), kao i o članku "The Area Method - A Recapitulation" o metodi površina (autori: Janičić, Narboux, Quaresma).

- **Danijela Petrović** (Matematički fakultet, Univerzitet u Beogradu)
  Uvod u formalno dokazivanje teorema

  Apstrakt:
  U ovom izlaganju biće prikazan Isabelle, programski jezik osmišljen za lakše pisanje i dokazivanje definicija, teorema, lema, pomoću kompjutera. Na početku predavanja biće objašnjeni osnovni pojmovi. Zatim će biti pokazani primeri dokazivanja teorema iz matematičke logike. Dokazi će biti pisani u Isar-u, proširenju Isabelle tako da su dokazi čitljiviji.

21.05.2010.

- **Florian Haftmann, Filip Marić** (Fakultät für Informatik, TU München; Matematički fakultet, Univerzitet u Beogradu)
  Towards a verified parallel SAT solver

  Apstrakt:
  We present work in progress, which combines two milestones involving code generation from Isabelle/HOL:

  a) data refinement

  Data refinement, i.e. the replacement of data structures by other (more efficient) ones, is a central task in program development. We show how this acticity will be supported by Isabelle/HOL and its

code generator with only a minimal extension of the trusted code base.

b) parallelizing in functional programming languages

The ancient continuous speedup of ever newer CPUs has come to an end – to take advantage of progress in hardware design, programs must exploit parallization. We take a bluffer's glance how this has been undertaken in Isabelle/HOL, casting a light how parallelizing can work out in functional programming languages in general.

23.06.2010.

- **Ivana Tanasijević** (Matematički fakultet, Univerzitet u Beogradu)
  Primene prostornog rezonovanja

  Apstrakt:
  U izlaganju će biti reči o prostornom rezonovanju sa gledišta njegove praktične primenljivosti. Kroz nekoliko primera će biti ilustrovano kako se može prepoznati prostorni aspekt u nekim zadacima i upotrebiti prostorno rezonovanje za njihovo rešavanje.

- **Mladen Nikolić** (Matematički fakultet, Univerzitet u Beogradu)
  Laički uvod u algoritamsku teoriju informacija

  Apstrakt:
  U ovom izlaganju će biti opisani osnovni pojmovi algoritamske teorije informacija kao što su Kolmogorovljeva složenost, slučajne niske, broj Omega, kao i njihov značaj za razmatranje nepotpunosti aksiomatskih sistema.

ARGO seminar 2009/2010

Vesna Pavlović

04.10.2010.

Argo seminar is a regular seminar of the Argo group. Main fields discussed are Automated Reasoning and Applications, Theoretical Computer Science, Artificial Intelligence and Data Mining. The seminar is dedicated mainly to PhD students in Computer Science. One meeting typically consists of two lectures: a tutorial one (where known results on one specific topic are presented) and a research one (where original research work is presented).

Meetings take place once in two weeks, usually on Wednesday at 5:15PM, in the premises of the Faculty of Mathematics in Jagićeva street.

Argo seminar has started in academic year 2007/08.

The seminar's leader is Predrag Janičić, and a seminar's secretary is Vesna Pavlović.

1 Given talks

04.11.2009.

- **Filip Marić** (The Faculty of Mathematics, University of Belgrade)
  Report on attending the conferences SAT2009 and TPHOLs2009

  Abstract:
  This talk will present impressions from the conferences SAT2009 (Swansea, United Kingdom) and TPHOLs2009 (Munich, Germany). The SAT conferences are dedicated to the theory and applications of satisfiability testing, and TPHOLs conferences are dedicated to formal and interactive theorem proving in higher-order logics.

- **Mladen Nikolić** (The Faculty of Mathematics, University of Belgrade)
  Introduction to geostatistics

  Abstract:
  Geostatistics is a part of statistics specialized for analysis and interpretation of spatial data. In this presentation basic prediction method will be shown. Also, it will be shown how geostatistic analysis can be performed using free tools like R, SAGA and Google Earth instead of using expensive commercial software.

18.11.2009.

- **Vesna Pavlović** (The Faculty of Mathematics, University of Belgrade)
  Report on a research visit to Polytechnical University of Valencia

  Abstract:
  Within Tempus DEUKS project I was staying at the Polytechnical University of Valencia, Spain, as a visiting researcher from May 1st till July 28th. The main topic of my work was automatic generation of linear elementary interpretations for proving termination of a given term rewriting system. In this lecture basics of term rewriting systems and methods for proving its termination will be presented, along with the specific problem I was working on.

- **Ivana Tanasijević** (The Faculty of Mathematics, University of Belgrade)
  Spatial representation and reasoning

  Abstract:
  The need for spatial representation and reasoning has taken a special place in many spheres of Artificial intelligence. This presentation is an overview of basic concepts, where the emphasis is on the qualitative spatial representation and reasoning problems. How these problems can easily be transformed into the problem of consistency, it will be here a word about the approach of that particular problem.

16.12.2009.

- **Bojan Marinković** (Mathematical Institute of the Serbian Academy of Sciences and Arts)
  DEUKS internship: On the Interconnection of Heterogeneous Overlay Networks

  Abstract:
  From February 27th till May 25th this year I stayed at Sophia Antipolis, France. During this period, I worked in LogNet team of INRIA Sophia Antipolis - Mediterrane, under supervision of Luigi Liquori, head of the team. This was opportunity for me to enter to the new field of my research - distributed systems. Final goal was to develop a software which will follow algorithm described in the paper: L. Liquori, C. Tedeschi, and F. Bongiovanni: BabelChord: a Social Tower of DHT-Based Overlay Networks. In 14th Symposium on Computers and Communications (ISCC 2009). IEEE, 2009. Short paper. During this talk, it will be presented basics of overlay networks, distrubuited systems, chord and babelchord protocols.

- **Aljoša Obuljen** (The Faculty of Mathematics, University of Belgrade)
  A word alignment method based on bilingual corpora aligned at

sentence level

Abstract:
Automatic word alignment is one of the crucial problems in the statistical approach to machine translation (SMT). Various methods have been proposed for this task yielding different results. In this paper, we propose a simple ranking method for word alignment given a bilingual corpus aligned at sentence level. The method can also be applied to corpora aligned at any other level, such as paragraph or even larger text segments, provided that a suficient amount of aligned text is available. In other words, the method is robust as to the granularity of alignment. For purposes of this work, the sentence level alignment has been chosen, as the standard alignment technique in SMT. A bilingual corpus of moderate size (approx. 1M words per language) has been used to obtain results - an aligned Serbian-English corpus of texts related to education, finance, health and law (SELFEH - Serbian-English Law Finance Education and Health), one of the numerous resources developed within the HLT Group at the University of Belgrade.

30.12.2009.

- **Mladen Nikolić** (The Faculty of Mathematics, University of Belgrade)
Methodology of SAT solver comparison

Abstract:
Weighing improvements to modern SAT solvers, or comparison of two arbitrary solvers is a challenging, but important task. Relative performance of two solvers is usually assessed by running them on some set of SAT instances and comparing the number of solved instances and their running time in some simple manner. New, statistically founded methodology of their comparison will be presented.

- **Mirko Stojadinović** (The Faculty of Mathematics, University of Belgrade)
Good quality research, publishing results in journals and good management skills

Abstract:
In this lecture I'll present key problems regarding doing research, scientific writing, publishing and presenting results. Problems that also arise are how to successfully manage everything and how to write proposals for projects. I'll briefly compare supervision and PhD studies in Great Britain and Serbia. I have learned about all this on lectures held by Prof. Steve Quarrie, Ministry of Science and Technological Development. Prof. Quarrie has got long experience in scientific writing and publishing results in journals, and he works

as a reviewer in couple of international journals.

31.03.2010.

- **Djordje Stakić** (The Faculty of Mathematics, University of Belgrade)
  Instance-based machine learning

  Abstract:
  This talk will present methods of instance-based machine learning. These methods delay processing of training examples until they must label a new query instance. Significant representatives of these methods are: k-Nearest Neighbour Learning, Locally Weighted Linear Regression, Radial Basis Functions and Case-based Reasoning.

- **Predrag Janičić, Sana Stojanović, Vesna Pavlović, Mladen Nikolić** (The Faculty of Mathematics, University of Belgrade)
  Ideas for developing new theorem prover for coherent logic

  Abstract:
  In this talk we will be briefly discuss existing theorem provers for coherent logic (fragment of first-order logic in which many important theories can be expressed). One version of the prover is already developed within ARGO group and it is tested on theorems from geometry. It is based on approach called forward chaining which represents a good base for generating readable proofs. However, this approach is not powerful enough for proving hard theorems. The ideas how this approach could be extended using techniques from other domains (i.e. SAT solving), which could speed up the search significantly will be discussed and, also, how these techniques can be adapted to coherent logic.

14.04.2010.

- **Milan Banković** (The Faculty of Mathematics, University of Belgrade)
  SMT tutorial

  Abstract:
  Satisfiability Modulo Theory (SMT) is a problem of deciding whether, for a given first order formula A, exists a model of a given theory T that satisfies the formula A. SMT solving for different theories finds its application in many areas from hardware and software verification, scheduling problems, to different optimization problems. In this talk a general overview of SMT problems and their solving will be given. First, a brief theoretical introduction will be presented. Then some common theories frequently appearing

in SMT solving will be disscussed. Principles of modern SMT solvers will be presented, as well as their connection with SAT solving. Finally, a short overview of previous, current and future work of the Argo Group in the field of SMT solving will be presented.

- **Mladen Nikolić** (The Faculty of Mathematics, University of Belgrade)
  Some details of applied statistics

  Abstract:
  In this talk the notions of the p-value and the effect size in statistical hypothesis testing will be described. Their role in practice will be discussed. Several correlation based effect size measures will be briefly explained. The difference between the frequentist and the Bayesian approach to probability and statistics will be discussed.

12.05.2010.

- **Predrag Janičić** (The Faculty of Mathematics, University of Belgrade)
  Some news from the fields of geometrical reasoning and dynamic geometry

  Abstract:
  The talk will discuss some recent activities related to geometrical reasoning and to dynamic geometry: about the conference CADGME (Hagenberg, July 2009) and AD+GG (Castro Urdiales, February 2010), and about the article "The Area Method - A Recapitulation" on the area method (the authors: Janicic, Narboux, Quaresma).

- **Danijela Petrović** (The Faculty of Mathematics, University of Belgrade)
  Introduction to Formal Theorem Proving

  Abstract:
  This talk will present Isabelle, programming language developed in order to make easier writing definitions, theorems, lemmas, by computer. In the beginning of the section will be shown basic features. After that it will be discussed examples containing proves of some lemmas from mathematical logic. Proves will be written in Isar, extension of Isabelle, that helps better understanding.

21.05.2010.

- **Florian Haftmann, Filip Marić** (Fakultät für Informatik, TU München, The Faculty of Mathematics, University of Belgrade)
  Towards a verified parallel SAT solver

Abstract:
We present work in progress, which combines two milestones involving code generation from Isabelle/HOL:

a) data refinement

Data refinement, i.e. the replacement of data structures by other (more efficient) ones, is a central task in program development. We show how this acticity will be supported by Isabelle/HOL and its code generator with only a minimal extension of the trusted code base.

b) parallelizing in functional programming languages

The ancient continuous speedup of ever newer CPUs has come to an end - to take advantage of progress in hardware design, programs must exploit parallization. We take a bluffer's glance how this has been undertaken in Isabelle/HOL, casting a light how parallelizing can work out in functional programming languages in general.

23.06.2010.

- **Ivana Tanasijević** (The Faculty of Mathematics, University of Belgrade)
  Applications of spatial reasoning

  Abstract:
  This talk will present spatial reasoning from the view of its practical applicability. Through several examples will be illustrated how spatial aspect can be recognized in some tasks and how thay can be resolved using spatial reasoning.

- **Mladen Nikolić** (The Faculty of Mathematics, University of Belgrade)
  A Layman Introduction to Algorithmic Information Theory

  Abstract:
  In this talk, elementary concepts of algorithmic information theory will be described, some of those being Kolmogorov complexity, random strings, Omega number. Also the importance of these concepts for incompleteness of formal axiomatic systems will be discussed.

ADG 2010, Munich, July 2010

Vesna Pavlović, Sana Stojanović

05.10.2010.

From July 22^{nd} to July 24^{th} 2010 we participated at the ADG conference (Automated Deduction in Geometry) which was held at Technical University of Munich, Germany. This conference is a leading conference in the area of automated reasoning in geometry. There were around 30 participants at the conference and the conference had very cozy and friendly atmosphere. Organizers of the conference, led by prof. Jurgen Richter-Gebert, gave there best to make our stay there very pleasant.

Slika 1: Building of Mathematics and Computer Science at Technical University of Munich

Participants of the conference were: Jacques Fleuriot, Pascal Schreck, Julien Narboux, Pedro Quaresma (latter two had visited our research group in the past), Pavel Pech, Nicolas Magaud, Francisco Botana, and many more. Many of them came with their PhD students. It was very useful for us to meet all these people because in the last years we read some of their papers and got familiar with their research topics. So we discussed some common problems and got a useful feedback for our work.

We used our stay in Munich to visit the Isabelle research group founded at Technical University of Munich. People from this group are developing formal theorem prover Isabelle. Since the prover that we presented at the conference generates formal proofs that can be checked with Isabelle we used this opportunity to present them our prover and discuss some joint problems.

The meeting was organized by Florian Haftmann who is a regular member of our Workshop and collaborates with some people from our group. We had a very useful three-hours talk with prof. Stefan Berghofer who is developing (together with Marc Bezem) a prover for coherent logic in ML which can be directly used in Isabelle as a built-in tactic.

Slika 2: Group photo at the Olympic tower

1 Our talk

At the ADG 2010 Sana presented our paper named "Automated Generation of Formal and Readable Proofs in Geometry Using Coherent Logic". We proposed a theorem prover ArgoCLP based on coherent logic that can be used for generating both readable and formal proofs in various theories, primarily geometry. The idea is that we are able to automatically generate proofs which are readable and therefore can be used in educational purposes; and because they are formal they can contribute to the growing body of formalized mathematics.

Q (Narboux): Did we make a comparison to other provers?

A: Not jet, after we develop support to TPTP format we will be able to make the comparison.

Q (Narboux): Do we loose completeness with introduction of negations?

A: We do not loose completeness because the negation we are intoducing is not the real negation. We introduce negated symbols as new relations and we add new axioms that preserve completeness.

Q (Fleuriot): Did you implement some techniques that are suitable for geometry specifically?

A: No, we restrained completely from that, because we wanted to have a general prover for all coherent theories.

Q (Thery): Do we try to find the shortest proof (so once we prove the theorem we try to find another proof)?

A: Our procedure is deterministic and axioms are always in the same order. It is theoretically possible that there exists a shorter proof with less number of steps.

2 Munich

Munich is the third largest city in Germany and one needs much more time than we had to explore it well. Anyway we did our best - we walked few times through the city center, once with an official guide (this was managed by the conference organizers) and we went to a Nymphenburg castle, situated in the suburbs of the city. Official guide took us through the main pedestrian zone, we visited a couple of important churches, central market and Olympic complex. Everyone says that the Deutsche Museum is a must see, but we did not manage to visit it. The conference dinner was organized in the restaurant at the top of the Olympic tower. Unfortunately the weather was a typical german weather so we did not manage to see much from the top.

Slika 3: Gardens of the Nymphenburg castle

We were staying in Garching, a city near Munich, which was one metro station far from the conference venue. Garching is a small, green and quite place, which we found very cute and pleasant. We were staying in Hoyacker Hof hotel (we paid around 100 Euros for double-bed room per night). The average price of a meal is 15-20 Euros with a drink. Typical food for Bavaria are sausages in all variants, and of course - beer.

The price of the airplane ticket for round trip Belgrade – Munich with Lufthansa was about 190 Euros. It took us around 1.5 hour to reach Munich from Belgrade and then around 2 hours to reach our accommodation (because of the lack of direct metro line from the airport to Garching).