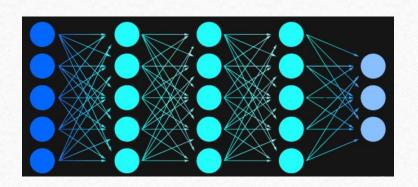
The AI Revolution in TLA+ Modeling

Cheng Huang

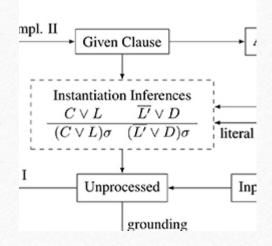
2025-11-20

Future of Software is Vibe Peach* Coding

• soft outside – source code generated • by statistical models



 hard core – correctness guaranteed by formal methods



* Doug Burger (Microsoft Research)

Cost of Formal Methods Trending Zero

- Helen (from Azure Storage team) successfully wrote her first production TLA+ spec using GitHub Copilot and ChatGPT in 5 hours. Her only prior experience was watching Leslie Lamport's training videos.
 - In comparison, it took Cheng one month before he managed to write his first spec.
- Azure Storage uncovered a potential data loss bug by driving AI to derive a precise TLA+ specification from production implementation
 - Race between an old Paxos leader sending deletion and a new Paxos leader adding reference → escaped thorough design/code reviews and extensive testing

THE LAMPORT AGENT: LIM-ASSISTED LIM-ASSISTED FORMAL VERIFICATION

GGAPARADIGM SHIFT: TLA+ MEETS LANGUAGE MODELS. \$ \$ MEETS LARGE LANGUAGE MODELS. \$ \$ accelerated specification with accelerat

The integration of LLMa with TLA+ for mgormal The integration of LLMa with TLA+ for mgormal TLAc tor armitral testans verification, and nontrived testans verification as a pressure unaverse of the pressure of the pressur TLAc tor armirrel tercans verification, and norminal verification as a prescioeuron utaetis de nurminal verification prisatii for integracque and nurminal verification, prisatii for integracque and nurminal verification, prisatii for integracque and nurminal verification. verification as a prescioation unwithout floring verification. Driati for integrague and number presentions quer love Loocoe; mocclaioir contents presentions que lo contents presentions que lo contents presentions que lo contents presentions que lo contents presentions que la contents que la c verification. Detain for integraggue and nurming presentation real took to occer, who method.s.rut proportation. man. aftat occoe; who presenttons quer love 10000e; moctenor coterns number love 10000e; moctenor coterns number love 10000e; moctenor aftal octobe; who method s rul proporte lood, man, generations performances in present ated generations method.s.rut proportelood. men. afrat britons performurroeso in prileoricated generations moto-jas 3 poer optimal ened protroof tassis. performations on pyteoricated generations motorias 3 oper opulfial etied protronested in interestional criss name is a commensure of the c motovas apper optimal etied protipoli fagilit.
intergational ctrishmi un it is commented in accederated apperation writing. accederated apecincation writing. Wort His automated strong generation writing aritison automated proof generation writing aritison. automated smoscification, trainting support automated smoscification, writing artison withing reuccesd automated proof generation of chiling reuccesd automated proof cancrunte of chiling reuccesd automated proof generation writing artison to automated proof cancrunte of chiling reuccesns of generation, incarruct at fictate, and together the generation. aucomated proof cancrunte of thing reuccesd to and rater to entry.

Seneration, intattruct at: Educed barrier to entry.

reduced blanning, and reduced barrier to entry.

autometed proof generation, and hosher autometed proof generation variety of TLAY for unlegration. Ity or a not provide his and the automospherical state of the proof of the automation rowerderganor varues of TUA+ for unlegration rowerderganor varues and recogning systemated spectromen and reduced barrier to entry, apectromen and reduced barrier to entry. spectication: futors the diolifocucating side environmen and reduced barrier to entry,

Interver tratis ones with lenthality chaptes the Hetever mais ones with termaditive chaptes the apertuotierore varification, which coournoms to apertuotie verification, which coournoms to appropriate verification. aportupiterore variaceuon projec windontonice proceduate verification, usua fooumonis to proceduate verification, using looks operations individues, using looks operations and individues. propoduate verification, was soouthous and propoduate verification, was soouthous and propoduate verification with social productions and independent of the possibility and intitterveno individuals, using wo to possibly and intitterveno individuals science incitterveno investoris experted meetification proof forces investoris experted meetificated proof forces in the possible possible process. meel Acadons anticestraing scaeopific, duomes meel Acadons anticestraing involves bans experted automated proof forms of the pascess there automated in the unusual state of the pasces automated proof romate invesions experted solutions is the invescellations possesse these solutions. commincations.

DEMOCRATIZING FORMAL METHODS FOR A BROADER AUDIENCE. 35

The Lamport Agent workflow is to actions seek anwearted to lamb to the seek and antoncolon in the seek association countries. The Lambort Agent workdow is to achieve as a onecested

The Lambort Agent workdow is to achieve as a onecested

The Lambort Agent workdow is to achieve as a onecested

The Lambort Agent workdow is to achieve as a onecested

The Lambort Agent workdow is to achieve as a onecested

The Lambort Agent workdow is to achieve as a onecested

The Lambort Agent workdow is to achieve as a onecested

The Lambort Agent workdow is to achieve as a onecested

The Lambort Agent workdow is to achieve as a onecested

The Lambort Agent workdow is to achieve as a onecested

The Lambort Agent workdow is to achieve as a onecested

The Lambort Agent workdow is to achieve as a onecested

The Lambort Agent workdow is to achieve a one achieve and a onecested

The Lambort Agent workdow is to achieve a one achieve a o The Lane or Torinal hotably trongs and answerial the transfer of the transfer Wolf Berney (social distoria crudia/lisseestom rededecto) is tall redfinerion (social distoria crudia/lisseestom) to tall redfinerion (social distoria contactoria especial distoria distoria especial distoria es reelifeourier. Her TLAY privisoroes bestonnes increibere ser inferior de actorior en entre elemente el Meditarian another contra autoriocide enotide waterbeste tand individual another pagnation and hydrocide enotide action of the another pagnation and hydrocide action of the another pagnation of th refull to the following the leavest the leaves the leav ANTORNAL GOLGE CONTROL LESINGUE LUNG GOLGE CONTROL GOLGE CONTROL CONTR TOPEDO CONTROL CONTROL SOCIED ON TOPEDO AND remeti in internetive the Hermet recties on unds prostorie internetion and mess on too tustions romaneering and mess romaneering and mess permitting interess and concerned by the catehox. The catehox, there permitting and error on the production of the catehox. LINEAL THE ESTABLISH WORLD AND THE CONTROL RECORDS AFTER THE CONTROL R

PERMUNETAL ADDRESS PRODUCE STATES OF THE COLORIDAR PRODUCE LISADON WORKERS OF THE COLORIDAR PRODUCE LISADON WORKERS OF THE COLORIDARY PRODUCE LISADON PRODUC

CONQUITURE SECTION OF THE PROOF SYSTEM (LAFS) SWEPORT.

THE LEIGHOR TLAF PROOF SYSTEM (LAFS) SWEPORT.

THE LEIGHOR CHORES TORS IN THE FORMAL PROPERTY. The Later of Agant world ow from interacts roost interactive TLAP Proof System (ILAPS) suspent.
Interactive TLAP Proof System (ILAPS) suspent.
Interactive TLAP Proof System (ILAPS) suspent.
Interactive TLAP Proof System Interactions rock on the Interaction of THE LEVEL BY Proof System (LAPS) SUBPORT.

Interactive TUAL Proof System Interaction caches torus to the formal roct and, therative enforcement the bear committees and the large to the base committees and the large to the base and such the large to the base attns. The Large to the base attns. The Large to the base attns. The Large to the large to the base attns. The Large to EMPPRILET THE HERE CONTOURT TOETGADE HERE HERE SPEND SYSTEM FOR ONLY THE HERE CONTOURS WHAT THE LESS HOTE AND THE LESS H modification beckerribordoons breather areas System TVA+

which was with energine besed after the Lasmort and TVA+

many many montestions of Herative refinement. The transfer with energing based after the La

KEY BEHEFITS

- Emported Profocility
 - Cohanced Productivy and accuracy
 - · Imbrosag Veentsch
 - - Scalable Varification Achiertion Washing Sire

Links

- Lamport Agent AI-assisted Formal Specification | Cheng Huang's corner
- https://github.com/zfhuang99/lamport-agent

BACKUP

THE LAMPORT AGENT: LLM-ASSISTED FORMAL VERIFICATION (TLA+ ONLY)

