Welcome to the **gem5 bootcamp** 2022

A presentation by

The Davis Computer Architecture Research Group

The Team

Prof. Jason Lowe-Power

Dr. Bobby Bruce

Marjan Fariborz

Kaustav Goswami

Mahyar Samani

Prof. Matt Sinclair

Ayaz Akram

Hoa Nguyen

Maryam Babaie

gem5

About you all!

At least 25 different universities

Some starting next year, most in their first year, a handful in 2nd and 3rd years

Learn more at lunch and other activities!

gem5

How the bootcamp will work

9am – 12pm Morning session

12pm – 1pm Lunch

1pm – 4pm Afternoon session

Mix of lectures and coding exercises

Using github codespaces for coding

Sign up at https://classroom.github.com/a/hM0bZ4xY

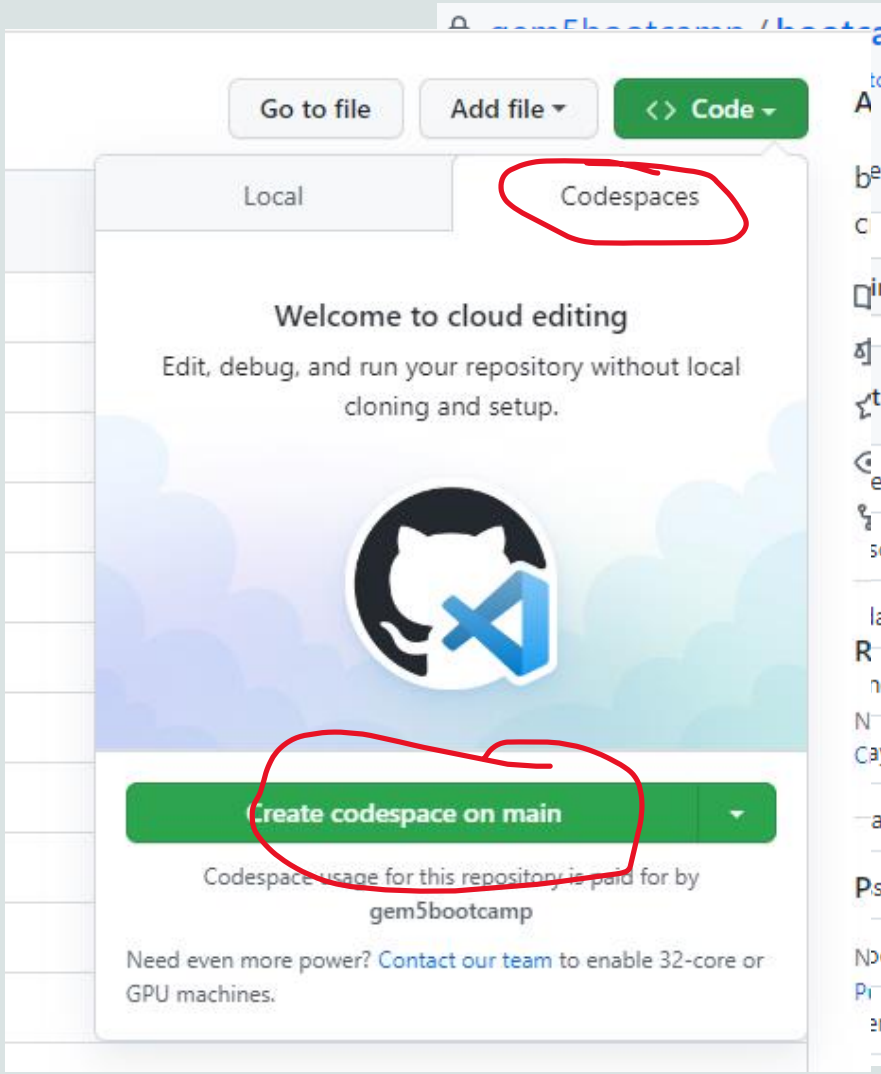
*Make sure to sign in to education.github.com

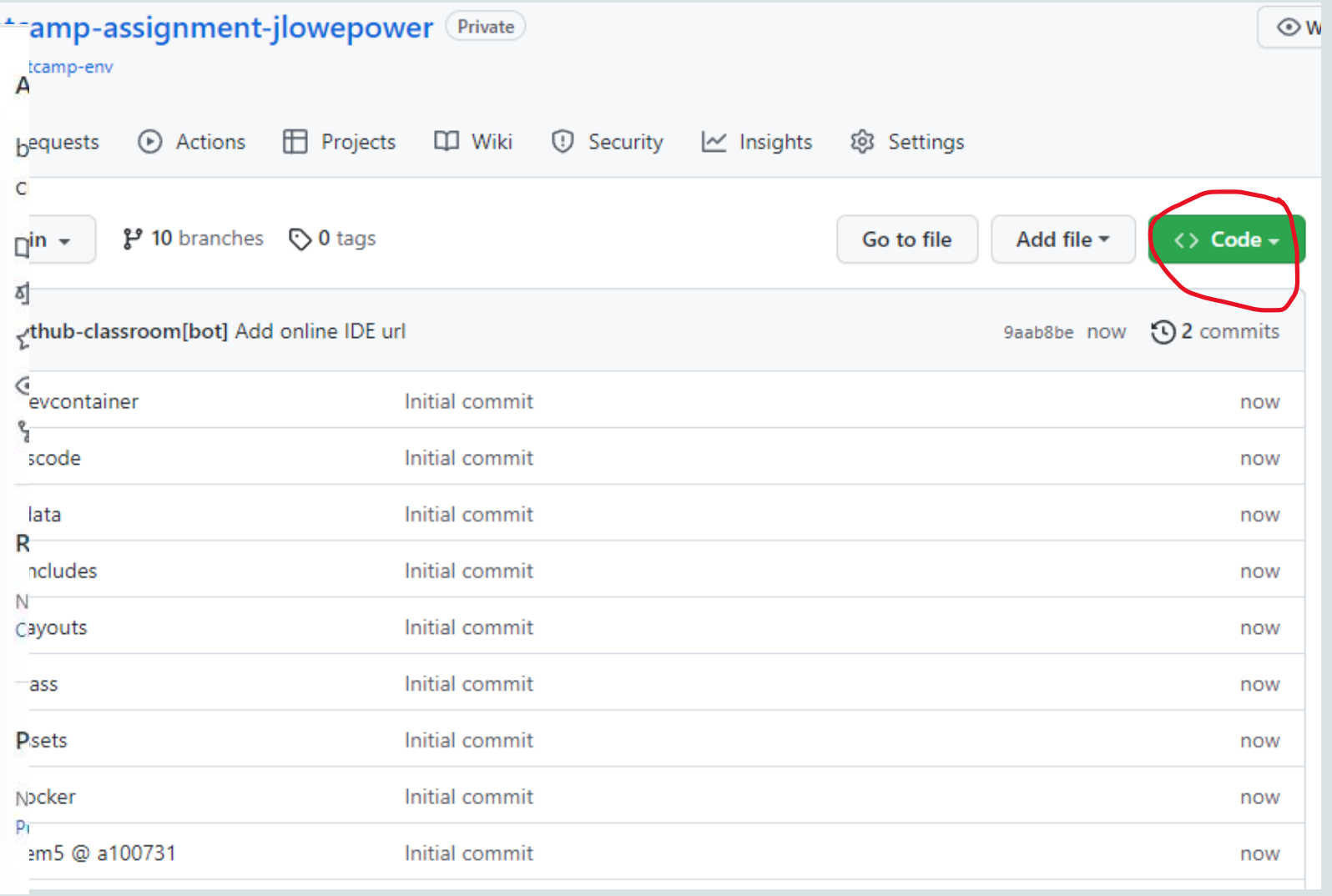
Find the slides here: https://tinyurl.com/gem5bootcamp-slides

Discussions on Slack: https://tinyurl.com/gem5slack

Getting started with Codespaces

https://classroom.github.com/a/hM0bZ4xY





Codespaces!

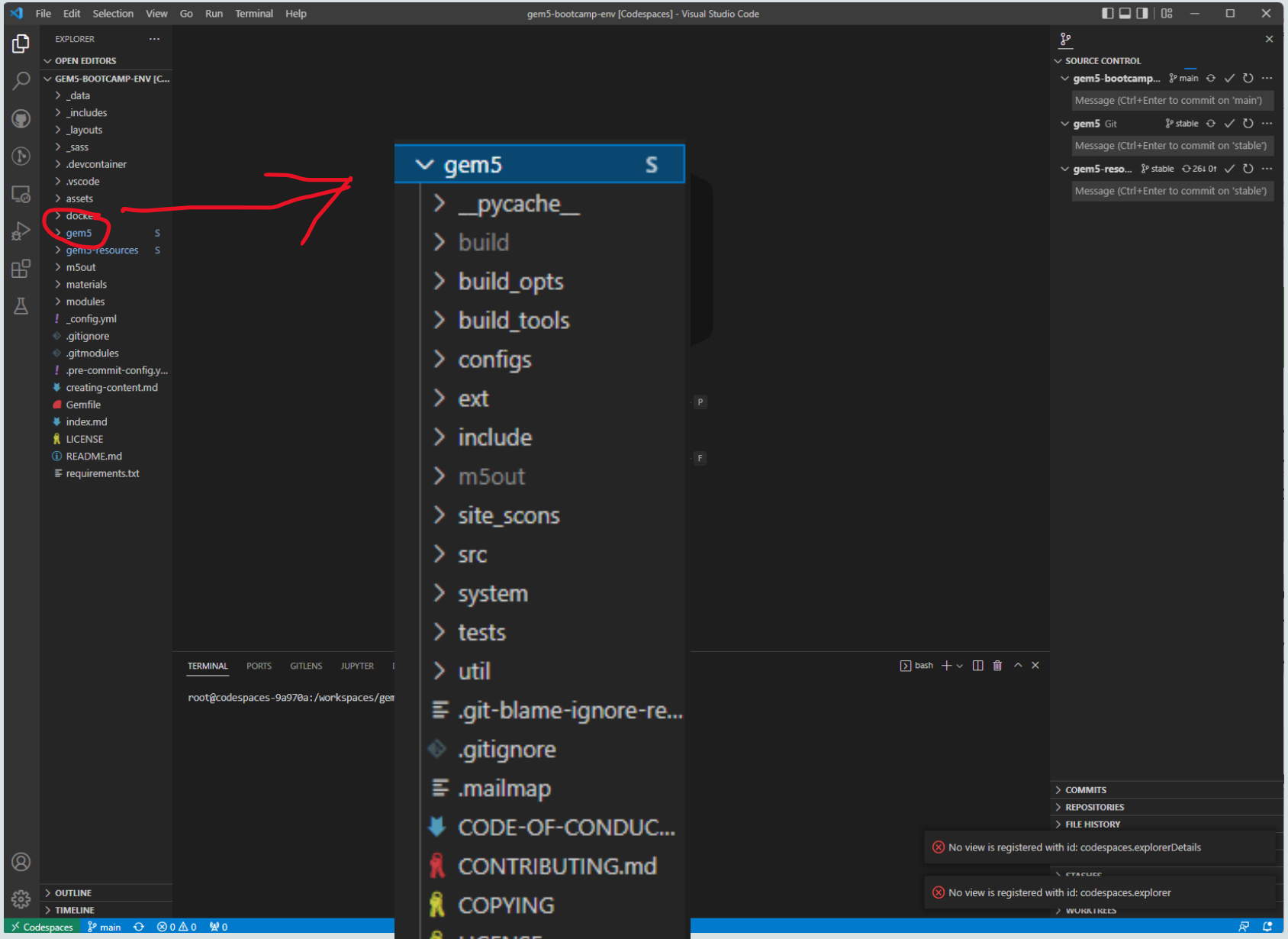
16 core VM

Use `-j17`

gem5 code, resources

Materials and reference for this bootcamp

Much more!



Plan for the week

Monday	Tuesday	Wednesday	Thursday	Friday
Introduction • Getting started with gem5: using, develop, and simulation	**Using gem5** • General using • gem5 models: caches, CPUs, memory	**gem5 devel** • First SimObject, params, events, memory ops	**gem5 devel** • Classic caches • Ruby and SLICC • OCN and Garnet	**Extra topics** • Contributing to gem5
Using gem5 • gem5 standard library	• Full system sim • Accelerating simulation	• Instruction execution • Adding an instruction	• gem5's GPGPU model	• Using other simulators w/ gem5 • **Whatever you want!**

My goals

Make gem5 less painful than it was for me

Give you a vocabulary for asking questions

Provide a reference for the future

Give you material to take back and teach your colleagues

Other admin things

Food is covered only at dining hall, Segundo (except travel and reception)

Reimbursement information on Friday (will include in email as well)

More resources

Bootcamp website: https://gem5bootcamp.github.io/gem5-bootcamp-env/

Classroom: https://classroom.github.com/a/hM0bZ4xY

Slack: https://tinyurl.com/gem5slack

Bootcamp source: https://github.com/gem5bootcamp/gem5-bootcamp-env

Code: https://gem5.googlesource.com/

gem5: https://www.gem5.org/

Code review: https://gem5-review.googlesource.com/

YouTube: https://www.youtube.com/channel/UCCpCGEj_835WYmbB0g96lZw

Created at Michigan by Steve Reinhardt and his students, principally Nate Binkert.

"A tool for simulating systems"

Two Views of M5

1. A framework for event-driven simulation
   - Events, objects, statistics, configuration
2. A collection of predefined object models
   - CPUs, caches, busses, devices, etc.

- This tutorial focuses on #2
- You may find #1 useful even if #2 is not

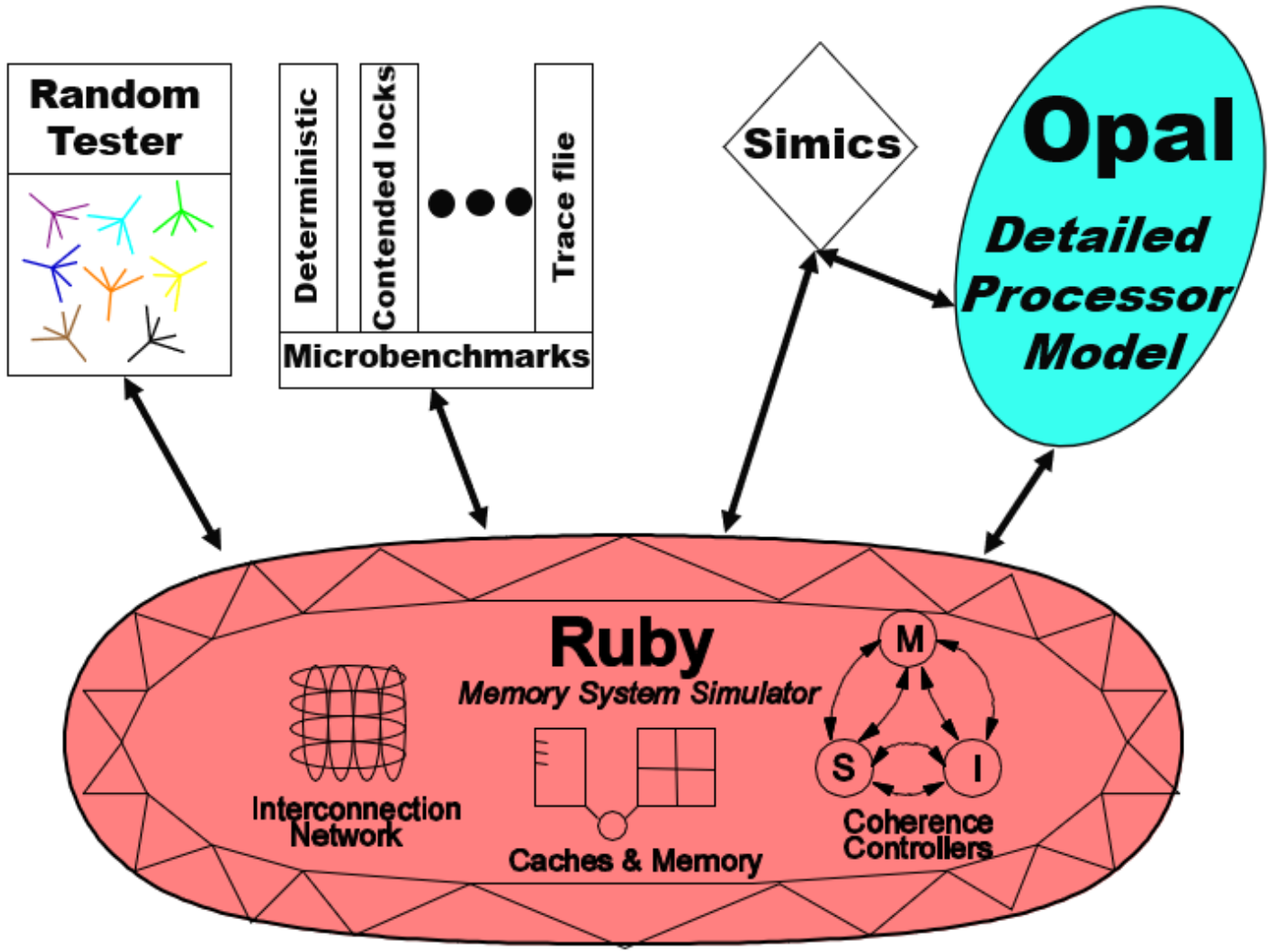
Created at Michigan by students of Steve Reinhardt, principally Nate Binkert.

"A tool for simulating systems"

Created at Wisconsin by students of Mark Hill and David Wood.

Detailed memory system

GEMS From 50,000 Feet



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Detailed memory system

What is gem5?

Michigan m5 + Wisconsin GEMS = gem5

"The gem5 simulator is a modular platform for computer-system architecture research, encompassing system-level architecture as well as processor microarchitecture."

Lowe-Power et al. **The gem5 Simulator: Version 20.0+**. ArXiv Preprint ArXiv:2007.03152, 2021. https://doi.org/10.48550/arXiv.2007.03152

Nathan Binkert, Bradford Beckmann, Gabriel Black, Steven K. Reinhardt, Ali Saidi, Arkaprava Basu, Joel Hestness, Derek R. Hower, Tushar Krishna, Somayeh Sardashti, Rathijit Sen, Korey Sewell, Muhammad Shoaib, Nilay Vaish, Mark D. Hill, and David A. Wood. 2011. **The gem5 simulator**. *SIGARCH Comput. Archit. News* 39, 2 (August 2011), 1-7. DOI=http://dx.doi.org/10.1145/2024716.2024718

Version 20.0

Abdul Mutaal Ahmad
Adrian Herrera
Adrien Pesle
Adrià Armejach
Akash Bagdia
Alec Roelke
Alexandru Dutu
Ali Jafri
Ali Saidi
Amin Farmahini
Anders Handler
Andrea Mondelli
Andrea Pellegrini
Andreas Hansson
Andreas Sandberg
Andrew Bardsley
Andrew Lukefahr
Andrew Schultz
Andriani Mappoura
Ani Udipi
Anis Peysieux
Anouk Van Laer
Arthur Perais
Ashkan Tousi
Austin Harris
Avishai Tvila
Ayaz Akram
Bagus Hanindhito
Benjamin Nash
Bertrand Marquis
Binh Pham
Bjoern A. Zeeb
Blake Hechtman
Bobby R. Bruce
Boris Shingarov
Brad Beckmann
Brad Danofsky
Bradley Wang
Brandon Potter
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Cagdas Dirik
Chander Sudanthi
Chen Zou
Chris Adeniyi-Jones
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Christian Menard
Christoph Pfister
Christopher Torng
Chuan Zhu
Chun-Chen Hsu
Ciro Santilli
Clint Smullen
Curtis Dunham
Dam Sunwoo
Dan Gibson
Daniel Carvalho
Daniel Johnson
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David Hashe
David Oehmke
Derek Hower
Deyaun Guo
Dibakar Gope
Djordje Kovacevic
Dongxue Zhang
Doğukan Korkmaztürk
Dylan Johnson
Earl Ou
Edmund Grimley Evans
Emilio Castillo
Erfan Azarkhish
Eric Van Hensbergen
Erik Hallnor
Erik Tomusk
Faissal Sleiman
Fernando Endo
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Gabe Loh
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Gene Wu
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Georg Kotheimer
Giacomo Gabrielli
Giacomo Travaglini
Glenn Bergmans
Hamid Reza Khaleghzadeh
Hanhwi Jang
Hoa Nguyen
Hongil Yoon
Hsuan Hsu
Hussein Elnawawy
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IanJiangICT
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Monir Mozumder
Moyang Wang
Mrinmoy Ghosh
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Nathanael Premillieu
Nayan Deshmukh
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Nuwan Jayasena
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Pin-Yen Lin
Po-Hao Su
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Richard Strong
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Stian Hvatum
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Trivikram Reddy
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Uri Wiener
Victor Garcia
Vilas Sridharan
Vince Weaver
Vincentius Robby
Wade Walker
Weiping Liao
Wendy Elsasser
William Wang
Willy Wolff
Xiangyu Dong
Xianwei Zhang
Xiaoyu Ma
Xin Ouyang
Yasuko Eckert
Yi Xiang
Yifei Liu
Yu-hsin Wang
Yuan Yao
Yuetsu Kodama
Zhang Zheng
Zicong Wang
jiegec
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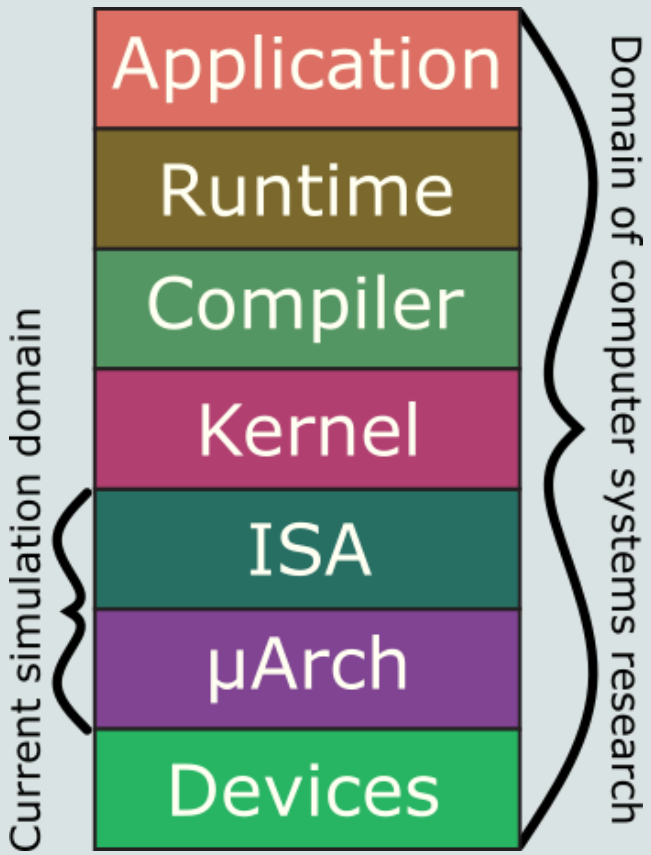
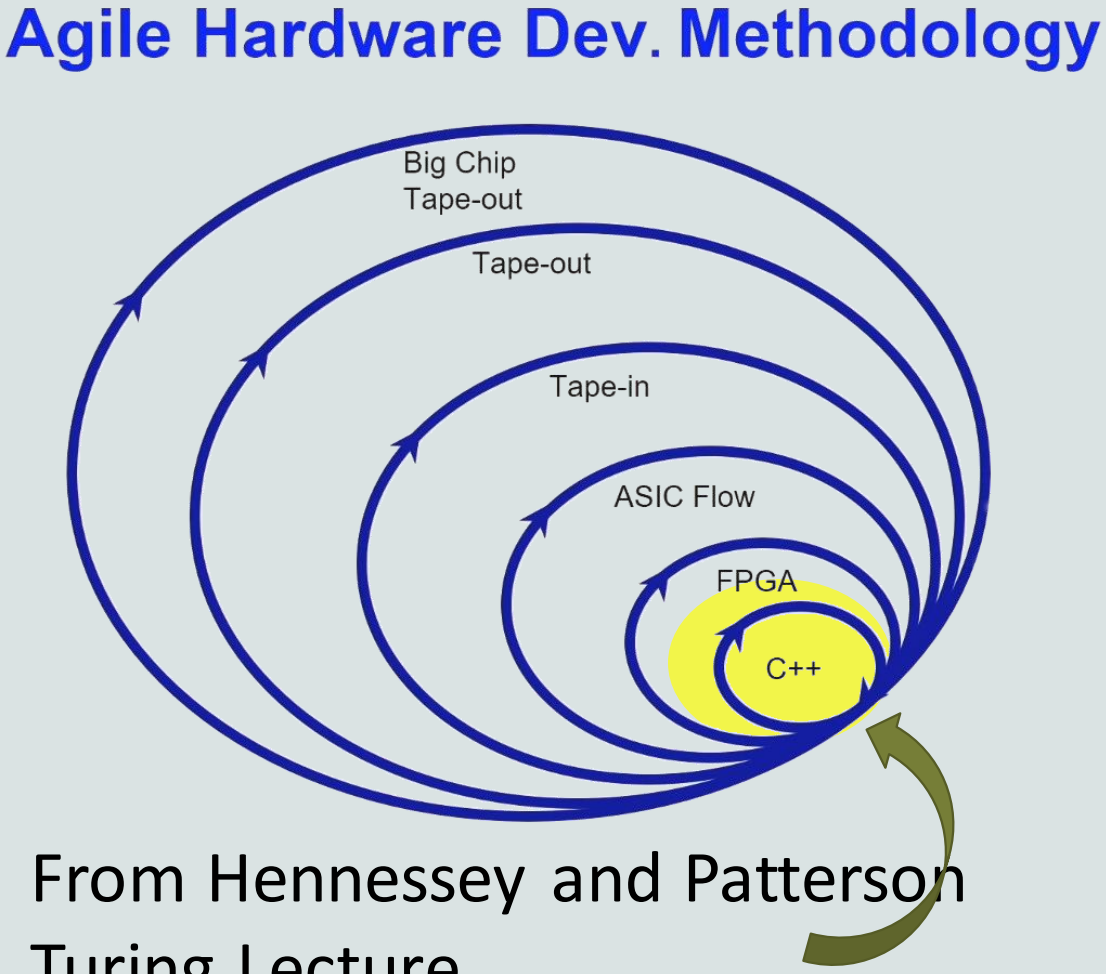
Éder F. Zulian

gem5's goals





From Hennessey and Patterson Turing Lecture

gem5

gem5's goals

Anyone (including non-architect) can download and use gem5

Used for cross-stack research:

- Change kernel, change runtime, change hardware, all in concert
- Run full ML stacks, full AR/VR stacks… other emerging apps

We're close… just a lot of rough edges! ***You*** **can help!**

The gem5 community

100s of contributors & 1000s(?) of users

Aim to meet the needs of

- Academic research (most of you all!)
- Industry research and development
- Classroom use

Code of conduct (see repo)

I want to see the community grow through more events!

What is gem5 useful for?

mod of guest OS protocol
simulate new device
test new proc. arch
test new ISAs
New NoC topologies
Model cache coherence
Novel consistency protocol

- Design space exploration
- System-level studies
- 5-10 year-out ideas
- Full-system simulation
- Flexible simulation methodologies
- Detailed cache coherence designs
- Multi-ISA studies

gem5

What is gem5 **not** useful for?

tiny bit-arch tweak

circuit-level design

physical properties → power/area

fast simulation

- Cycle accurate simulation
- Low-level microarch. details
- Circuit simulation
- Detailed power analysis
- Fast simulation
- Functional emulation only

gem5

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Today

Morning: Introductions

- Introduction to the bootcamp
- Computer architecture simulation
- Intro to using gem5
- Intro to developing gem5

Afternoon: Using gem5

- gem5's standard library