



Getting Started with gem5 development

Jason Lowe-Power

Outline

Why develop gem5?

Getting gem5 so you can develop

gem5's architecture

- SimObjects, models, parameters, and instances

- Discrete event simulation

Some coding best practices



Why develop gem5?



Downloading/building gem5

```
> git clone https://gem5.googlesource.com/public/gem5  
> cd gem5  
> scons build/X86/gem5.opt -j<number of threads>
```



```
> git clone https://gem5.goglesource.com/public/gem5
```

git: Version control system

<https://git-scm.com/book/en/v2>

googlesource: Main gem5
repo location (not github,
for now)

stable: The default branch for gem5.
Updated at stable releases.

develop is updated more frequently
(>1 per day)



```
> scons build/X86/gem5.opt -j17
```

scons: the build system that gem5 uses (like make). See <http://scons.org/>

build/X86/gem5.opt: “parameter” passed to scons. gem5’s *Sconscript* interprets this. Also, the path to the gem5 executable.

X86: Specifies the default build options. See [build_opts/*](#)

opt: version of executable to compile (one of debug, opt, fast)



gem5 architecture

gem5 consists of “**SimObjects**”

Most C++ objects in gem5 inherit from **class SimObject**

Represent physical system components



gem5 architecture: SimObject

Model

C++ code in **src/**

Parameters

Python code in **src/**

In SimObject declaration file

Instance or configuration

A particular choice for the parameters

In standard library, your extensions, or python runscript

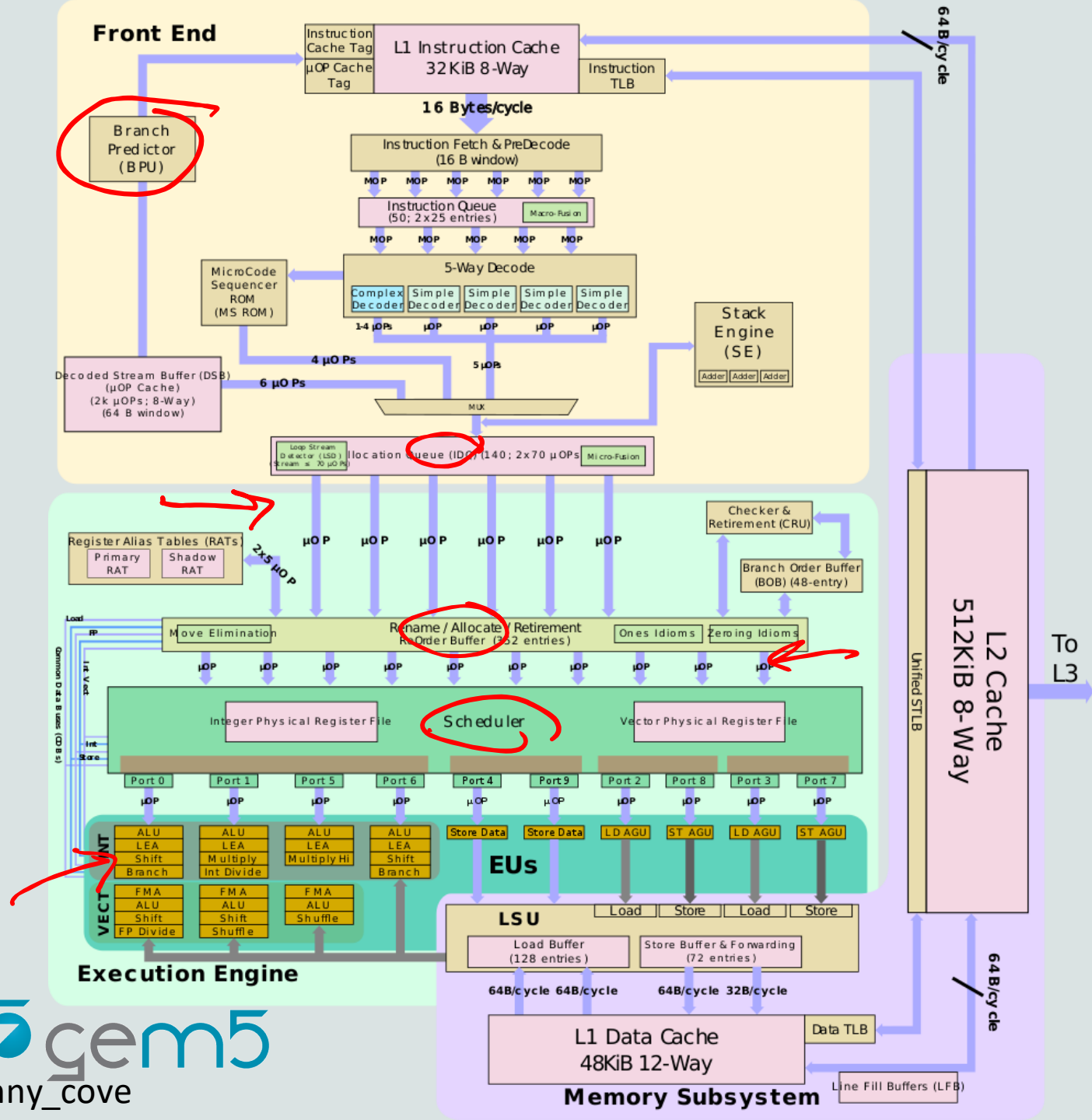


Model vs parameters

Generic model and timing in C++

Expose parameters to Python

Set parameters and connections in Python



Some nomenclature

You can ***extend*** a model to model new things

You would want to *inherit* from the object in C++

```
class O3CPU : public BaseCPU
{
```

You can ***specialize*** a model with specific parameters

You would want to *inherit* from the object in python

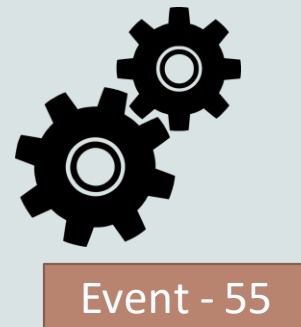
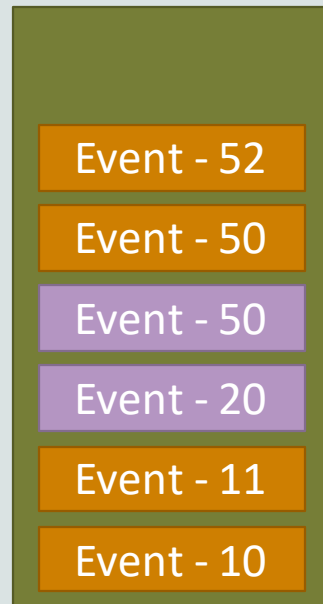
```
class i7CPU(O3CPU):
    issue_width = 10
```



gem5 architecture: Simulating

gem5 is a **discrete event simulator**

Event Queue

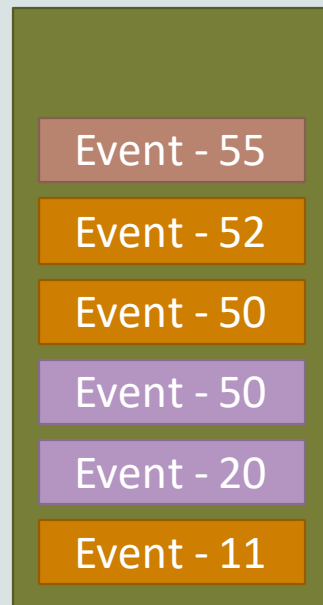


- 1) Event at head dequeued
- 2) Event executed
- 3) More events queued

gem5 architecture: Simulating

gem5 is a **discrete event simulator**

Event Queue

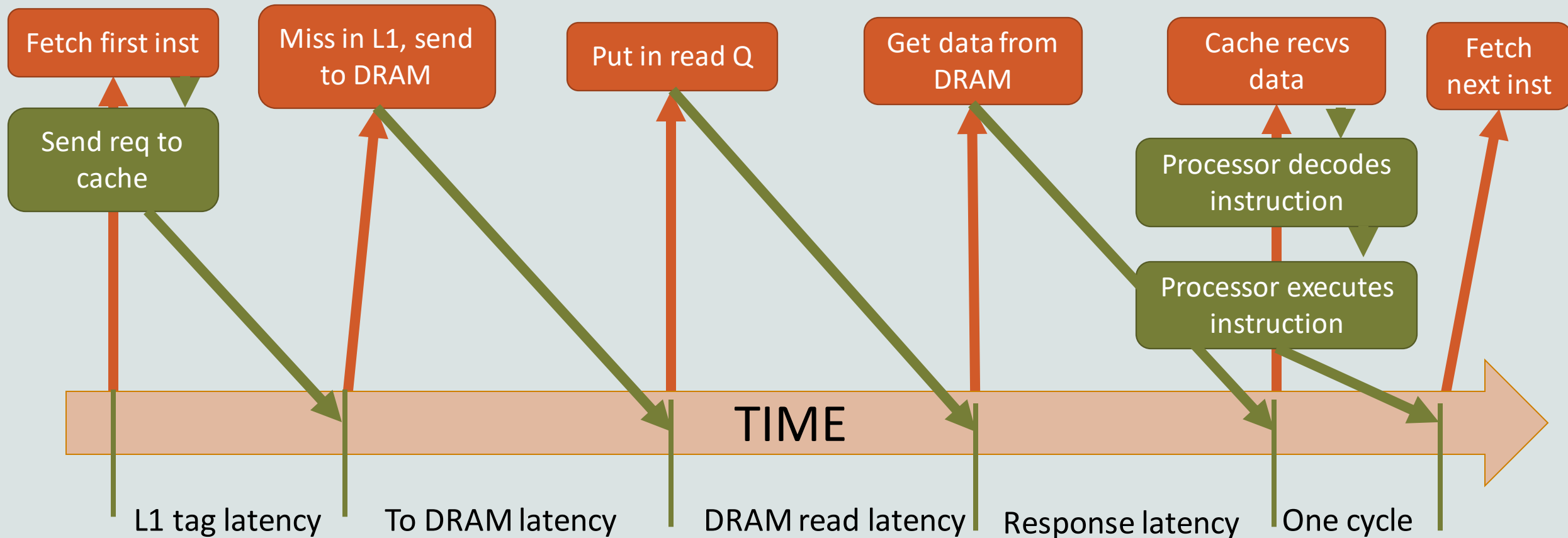


- 1) Event at head dequeued
- 2) Event executed
- 3) More events queued

We'll cover more later

All SimObjects can enqueue events to the event queue

Discrete event simulation example



Discrete event simulation

"Time" needs a unit

In gem5, we use a unit called "Tick"

Need to convert a simulation "tick" to user-understandable time

E.g., seconds

This is the global simulation tick rate

Usually this is 1 ps per tick or 10^{12} ticks per second



Being a software engineer

Always use good code style! See

https://www.gem5.org/documentation/general_docs/development/coding_style/

When you run `scons`, it will prompt you about this. Don't ignore!

Use git branches!

```
git switch -c jason/cool-new-feature
```

Write good commit messages:

<65 char short description. Think email subject. See `MAINTAINERS.yaml`

Explain why and what you did. Maybe other designs not chosen.

Code should explain how (in comments!)

See <https://google.github.io/eng-practices/review/developer/cl-descriptions.html>

