The Paper CPU: an activity for introducing CPU architecture – and to scaffold computer simulations!

### The Paper CPU Activity

**How it works:**
- Students do the activity in groups
- Each student acts as one of the four stages
- Students calculate and pass values around

**Goals:**
- Introduce CPU architecture
- Determine what a mystery program does

**How we implement it:**
- The activity is used as an introduction to CPU architecture
- It provides scaffolding for teaching a simulated Y86 CPU in Logisim
- At UBC we run the Paper CPU in lab followed directly by the Logisim simulation
- AT UToronto we do the activity on its own in tutorial

### Our Logisim Simulation

- Previously, we taught CPU architecture by starting with a circuit simulation of a "simple" CPU
- Students found even the simplest version of it overwhelming!
- We created the Paper CPU as an activity to scaffold the Y86 simulation

### Advantages of the Paper CPU

- Effective scaffolding: students become comfortable with the structure of a CPU
- Learning for the whole class: jumping to Logisim only benefited the top students
- Discovery learning: the students typically "discover" pipelining and data forwarding on their own.
- Collaborative learning: by putting students into a group to collaborate.
- Little overhead: little to no extra teaching load; reduces student questions later on.
- Notes for afterwards: students have a paper copy of their work to add to their notes for the class.
- Improved student buy-in: we survey our students after every lab; since adding the activity student feedback has improved significantly!

### You can do it too!


---

### Acknowledgements

- The Paper CPU has been developed with the feedback of UBC’s CPSC 121 students and TAs – a big thank you to them!
- The Y86 Logisim simulation was made by Patrice Belleville and Steve Wolfman, based on Bryant and O’Hallaron’s Y86 architecture.
- Development was partially funded by UBC’s CS Science Education Initiative.
- E.P. is supervised by Steve Easterbrook and Michelle Craig; travel funding from NSERC.