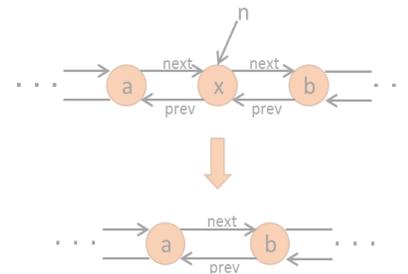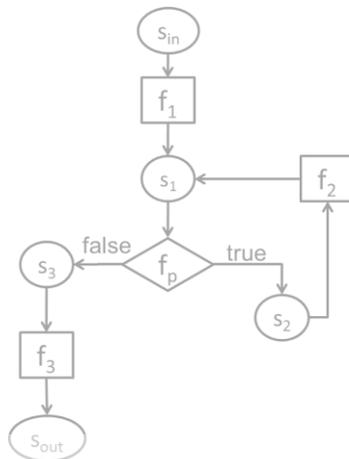$\exists c \forall in\ Q(c, in)$

```
/* Average of x and y without using x+y (avoid overflow)*/
int avg(int x, int y){
  int t = expr({x/2, y/2, x%2, y%2, 2 }, {PLUS, DIV});
  assert t == (x+y)/2;
  return t;
}
```
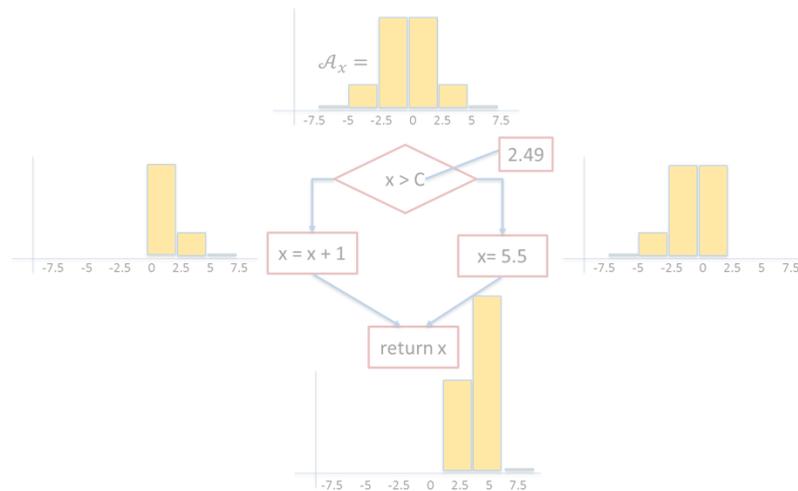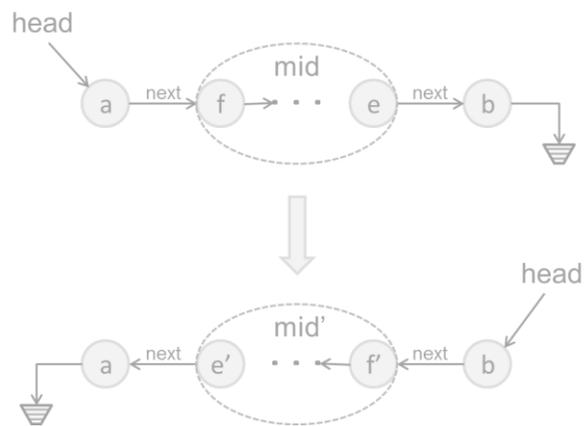
s_{in}
f_1
s_1
f_2
false f_p true
s_3
s_2
f_3
s_{out}

n
a next x next b
prev prev

a next b
prev

```
{
  s = n.succ;
  p = n.pred;
  p.succ = s;
  s.pred = p;
}
```

Welcome to Program Synthesis!

head
a next f mid e next b

head
a next e' mid' f' next b

$\mathcal{A}_x =$
-7.5 -5 -2.5 0 2.5 5 7.5

-7.5 -5 -2.5 0 2.5 5 7.5

2.49
x > C
x = x + 1   x= 5.5

-7.5 -5 -2.5 0 2.5 5 7.5

return x

-7.5 -5 -2.5 0 2.5 5 7.5

$\varphi(p)$

$Sk[c](in)$

Administrivia

Who are we?

Xiaokang Qiu

xkqiu@purdue.edu

Associate Professor of Electrical and Computer Engineering, Purdue University

Research interests: programming languages, formal methods, and software engineering, making programming easier, more reliable and more productive

How about you?
- We'd love to hear about your research!
- Attend my office hour!

What is this course about?

The goal of the course is to introduce program synthesis, one of the most central research problems in computer science and AI.

- You'll get familiar with state-of-the-art approaches to the problem including recent AI-powered advancements as well as open problem in the area.
- Each person is expected to learn one or more core techniques in detail and use it in a concrete project, giving a theoretical or practical contribution.

– First half: Lectures covering core synthesis techniques
– Second half: Paper discussion and project presentation
– No final exam

Logistics

Office Course Website
- https://xkqiu.github.io/purdue-ece663/
- Syllabus, Assignments, Slides, etc.
- Check regularly for latest announcements
- Reference book: *S. Gulwani, O. Polozov and R. Singh. **Program Synthesis**. 2017.*

Office Hours
- Tuesdays 1:45-2:45pm, Fridays 10:30-11:30am (BHEE 329)

Grading
- 30% — Assignments (three expected)
- 20% — Paper Presentation (lead discussion for a research paper)
- 50% — Project (apply program synthesis techniques to a project of your choice)

Project (tentative)

Quick pitch of your research (2%)
- Your classmates may be interested in joining
- Expectations commensurate with size of team

1-page project proposal (13%)
- Tell us what you plan to do, why the idea is novel (literature review) and give some evidence that you've started to work on it

Project presentation (15%)

Project report (20%)
- 5 pages in ACM Small format
- May lead to a future publication!

Hopefully be at the level of a conference publication. Will be judged in terms of
- quality of execution
- originality
- scope

Key Dates (very tentative)

February 13: Assignment 1 due

February 20: Paper assignment due

February 27: Project proposal due

March 24: Paper discussion begins

March 27: Assignment 2 due

April 16: Paper discussion ends

April 21: Project presentation begins

April 30: Project presentation ends

May 4: Project report due