Week 1- Introduction to model checking

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Chennai Mathematical Institute

NPTEL-course

July - November 2015

Course overview

What are we **interested** in?

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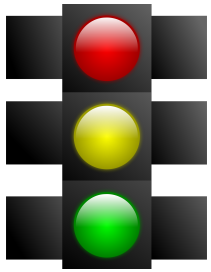
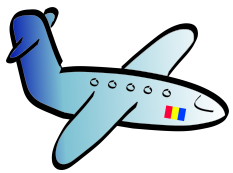
Software Controllers

Code that controls the working of an

Information and Communication (ICT) device



Traffic lights controller

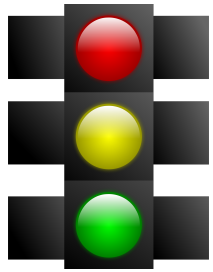


Flight control

Automatic gear control

ATM

Pacemaker



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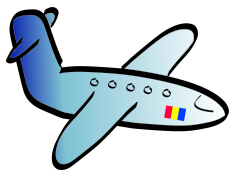

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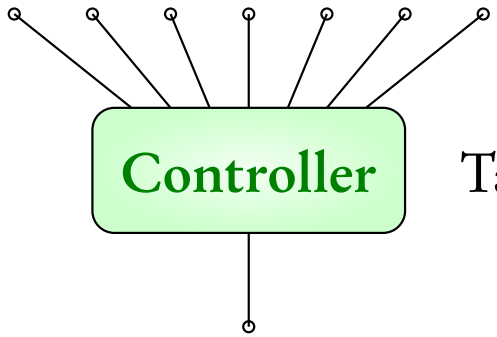
Lifts, Automatic doors, Hardware circuits, Netbanking ... and many more!

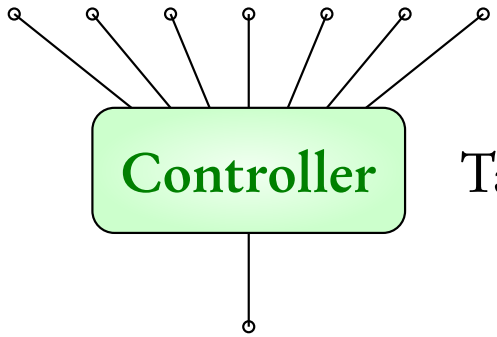
Listens to **various inputs**



Takes certain **decisions**

Gives **output action**

Listens to **various inputs**



Takes certain **decisions**

Gives **output action**

Many **safety-critical** systems controlled by code

How **reliable** is the controlling code?

- **decision making** should be correct
- **all possible scenarios** should be considered

Bugs are costly

- **Intel's Pentium II processor:**

  Error in floating point division code (1994)

  - Loss of 475 million US dollars

- **Ariane 5 rocket:**

  Error in the control software (1996)

  - Crashed 36 seconds after launch

- **Therac-25 radiation therapy machine:**

  Error in control software (1985 - 1987)

  - Death of 6 patients due to radiation overdose

Goal: Make **low-defect** software controllers

Traditional testing **insufficient** for safety-critical systems

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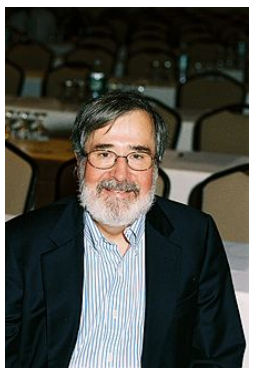
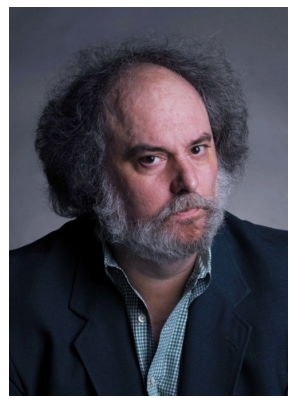
Traditional testing **insufficient** for safety-critical systems

→ A new **verification technology** called **Model-checking**



Edmund Clarke

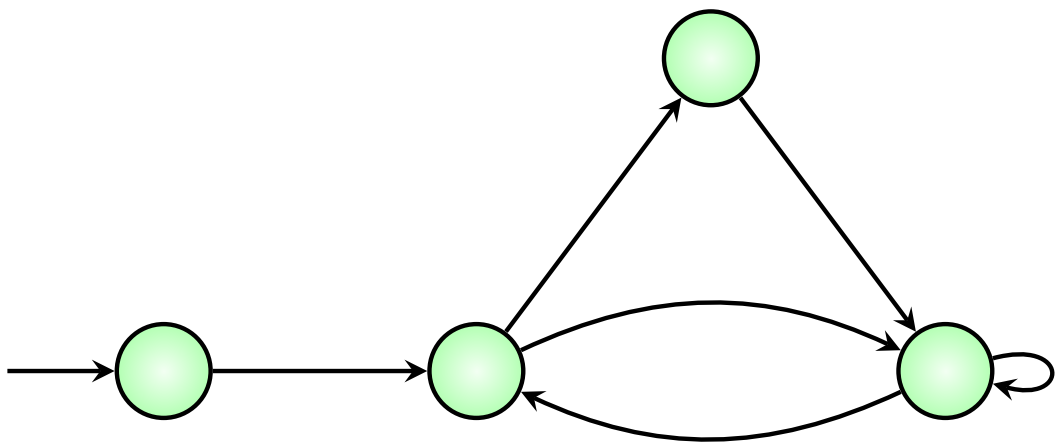


Allen Emerson

Joseph Sifakis

Model Checking

Uses **finite state machines** to model and **verify** controllers



Some places where **Model Checking** technology is **used**

- *Hardware:* Intel, IBM, Synopsys
- *Avionics:* Rockwell Collins, Honeywell
- *Automobiles:* Toyota
- *Space:* NASA, European Space Agency
- *Others:* Microsoft Research, Tata, Mathworks

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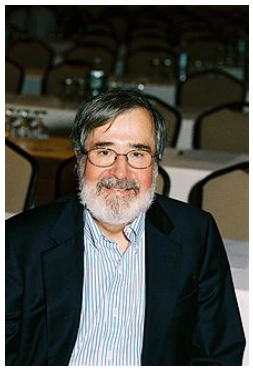
Backed by many **university groups** from all over the world!



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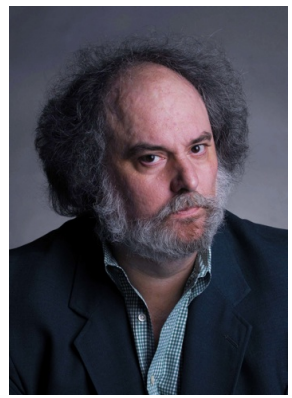

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Turing Award'07 for their work on Model-checking

Why do this course?

- Various **industries adopting** model-checking into their design cycle
- Need engineers **qualified** in model-checking technology
- Scope for **higher studies**

In this course

Introduction to **techniques and tools** used in Model-Checking

Book: Principles of Model Checking,
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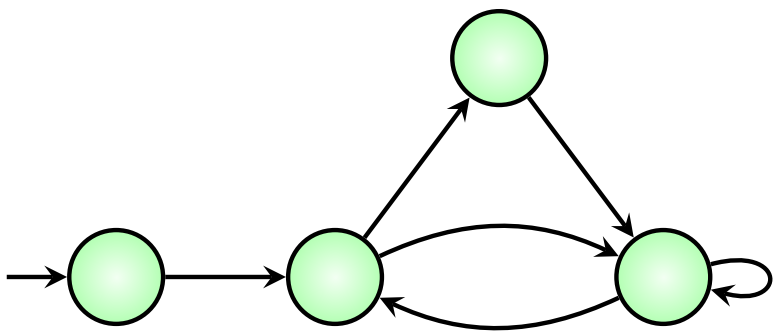

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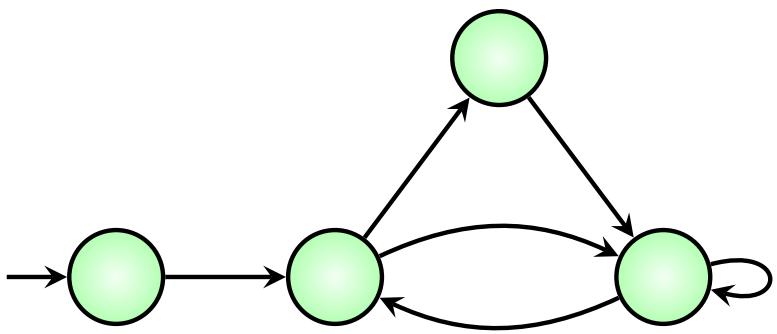

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Bachelors/Masters in CS/IT/EEE/ECE **welcome!**

Hope you'll **enjoy** the course!