Undergraduate Research
Mathematics and Computer Science

Jeff Kinne

Panel on Undergraduate Research
October 3, 2012

Slides online at kinnejeff.com

About Me

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- Assistant Prof, **Math and Computer Science**

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- 3rd year at ISU

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Goals

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- Experience for students, stimulate interest

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- Research results

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- Atmosphere among students, in department

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- Atmosphere among students, in department

Training researchers: **creativity, working independently, excitement, ...**

Projects

Project – Pseudorandom Number Generators

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- 2, 4, 6, 8, 10, 12

Project – Pseudorandom Number Generators

- 2, 4, 6, 8, 10, 12
- **next = last + 2**

Project – Pseudorandom Number Generators

- 3, 6, 9, 2, 5, 8

Project – Pseudorandom Number Generators

- 3, 6, 9, 2, 5, 8
- **next = (last + 3) % 10**

Project – Pseudorandom Number Generators

- 1, 8, 11, 10, 5, 12

Project – Pseudorandom Number Generators

- 1, 8, 11, 10, 5, 12
- **next = (5 * last + 3) % 16**

Project – Pseudorandom Number Generators

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PRGs

- Linear Congruential Generator

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- Linear Feedback Shift Register

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- ...

Why?

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- **Cryptography**

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- **Randomized algorithms**

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PRG Properties

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- How **secure**
- How **fast** to compute

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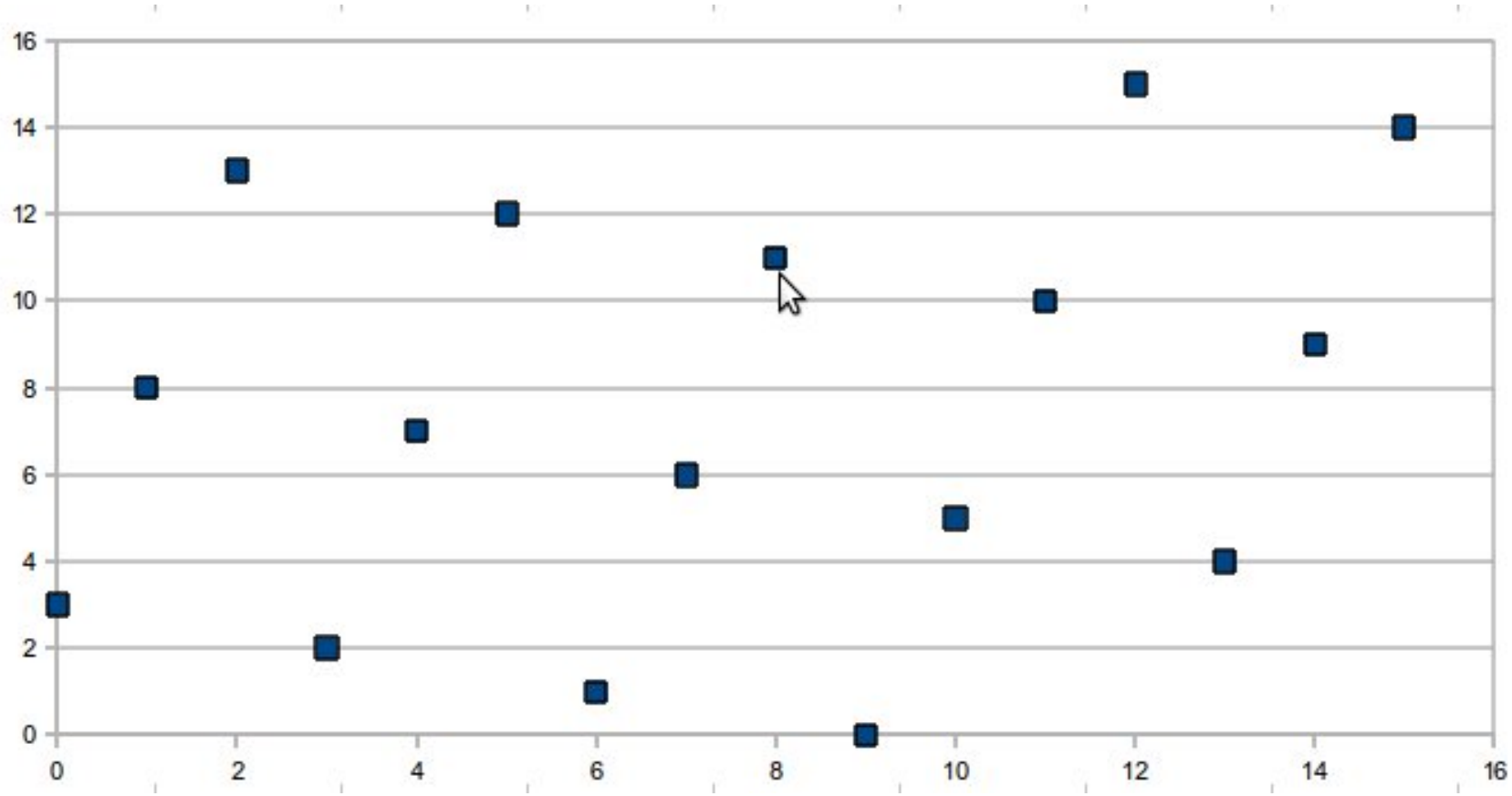
Our Research...


16
14
12
10
8
6
4
2
0
0
2
4
6
8
10
12
14
16

```
testPrime = int(raw_input("Enter number you wish to check is prime: "))
det = raw_input("y/n Deterministic?: ")
if det == 'y' or det == 'Y' or det == 'yes' or det == 'Yes' or det == 'YES':
    wiki = min(testPrime-1,int(2*(math.log(testPrime)**2)))
    reps = wiki
    det = 1
else:
  reps = int(raw_input("How many times would you like the test run: "))
  det = 0

start = time.time()
answer = MRtest(testPrime,reps,det)
end = time.time()
timer = end-start

if answer == 0: print "Probably prime!, in " + str(timer) + " seconds."
else: print "Composite " + str(answer) + ". It took " + str(timer) + " seconds."
```

Theorem A. *The linear congruential sequence defined by m, a, c, and X_0 has period length m if and only if*

i) *c is relatively prime to m;*

ii) *$b = a - 1$ is a multiple of p, for every prime p dividing m;*

iii) *b is a multiple of 4, if m is a multiple of 4.*

The ideas used in the proof of this theorem go back at least a hundred years. But the first proof of the theorem in this particular form was given by M. Greenberger in the special case $m = 2^e$ [see *JACM* **8** (1961), 383–389], and the sufficiency of conditions (i), (ii), and (iii) in the general case was shown by Hull and Dobell [see *SIAM Review* **4** (1962), 230–254]. To prove the theorem we will first consider some auxiliary number-theoretic results that are of interest in themselves.

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Paper and presentation at a workshop/conference?

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Other Project

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Brain oxygen monitoring/therapy – genetic algorithms

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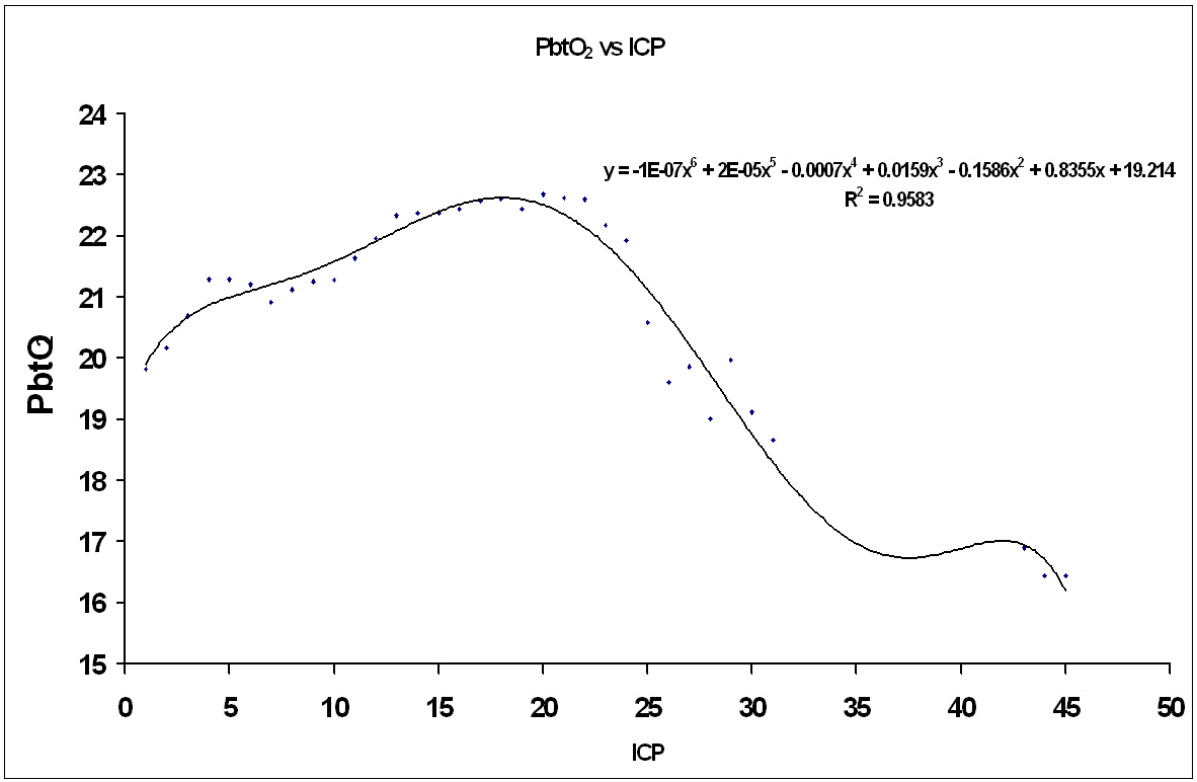

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Neural networks and genetic algorithms

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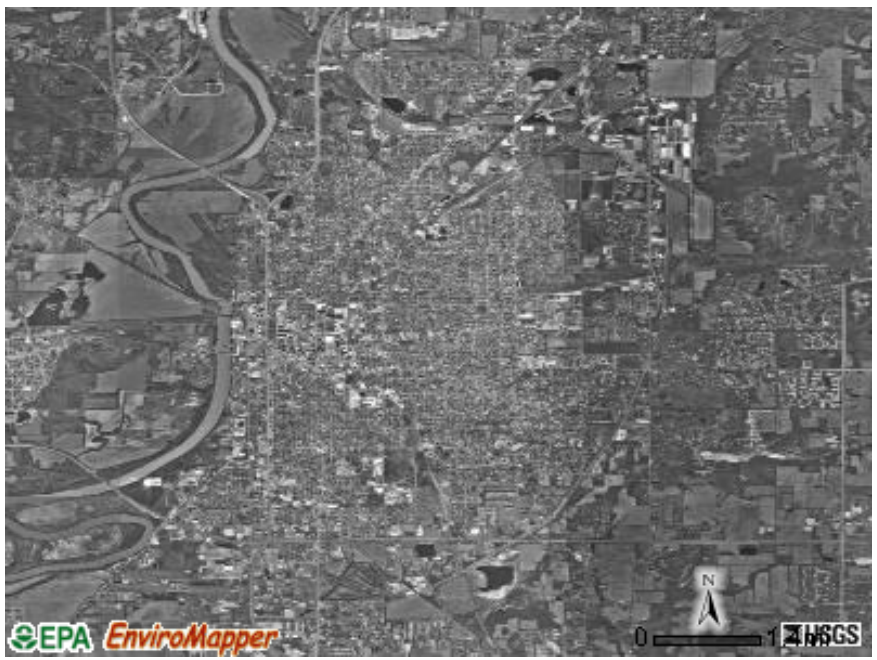

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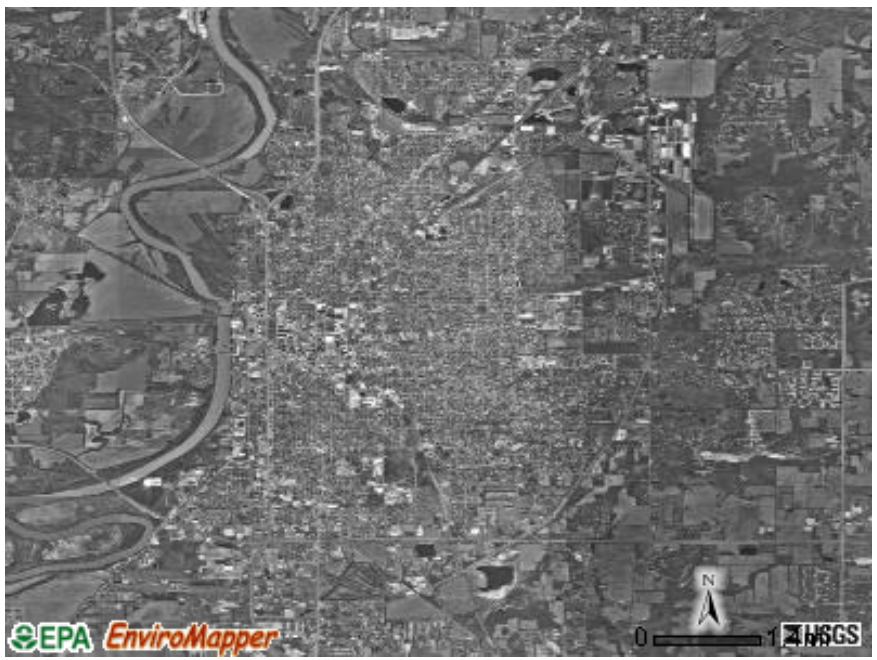
- **Satellite image processing**
- Game playing



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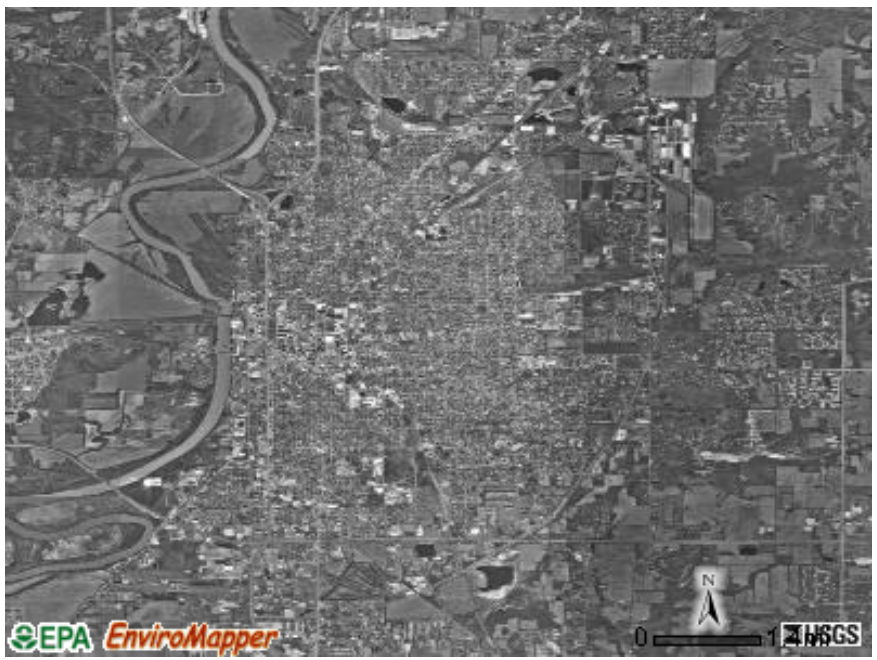

Reflection

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Have them work on **my projects or choose their own**?

- **Former:** my expertise, better chance at results
- **Latter:** their interest/independence/motivation

Discussion

Ask yourself...

- Why supervise undergraduate research?

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- What project ideas?

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- What is a successful outcome?

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- What is a successful outcome?
- Interdisciplinary research?

The end.

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