Computer Science & Engineering

Dr. Paul Sivilotti
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A Survey of First-Year Students

Medical students
“Why did you choose this field?”

Law school students:
“Why did you choose this field?”
• Computer science is everywhere

• And it is changing the way we live!
How We Connect With Friends

- Telephone
- Facebook
- Skype
- Twitter
- Gmail
- Flickr
How We Listen to Music
How We Shop
How We Get Information

Wikipedia
The Free Encyclopedia

Google

YouTube

Yahoo!
How We Play Games
Where is Computer Science?
Computer Science is Also...
Computer Science is Also...
Computer Science is Also...
Engineering the Physical World
import java.util.Stack;

public class SlowBigNatural implements BigNatural {
    // Private FIELDS
    private Stack<Integer> stackNum;
    private final int RADIX = 10; // Avoid hard-coding "10" into the problem.
    private int sign = 1;

    // Private (Local) Methods
    private void incrementRecursively(Stack<Integer> theStack, int radix) {
        if (theStack.empty()) {
            theStack.push(1);
            return;
        }
        // Determine if this digit can be simply incremented, or if it has to be
        // set to 0 and the next digit has to be incremented.
        int digit = theStack.pop();
        if (digit < (radix - 1)) {
            digit++;
        } else {
            digit = 0;
            if (!theStack.empty()) {
                // If the next digit exists (if there is something left in the
                // stack) make a recursive call to this method. Otherwise, push
                // the value 1 onto the stack.
                this.incrementRecursively(theStack, radix);
            } else {
                this.stackNum.push(digit);
            }
            // Push the digit back onto the stack, restoring the original
            // representation.
            this.stackNum.push(digit);
        }
    }

    // Decrements the digit at the top of the stack. If the digit is not zero,
    // the method will recursively call itself. If the digit is zero, the
    // method will push a 0 onto the stack. If the stack is empty, it will
    // start the process again. If the stack is empty but the digit is not zero,
    // the method will push a 0 onto the stack.
    private void decrementRecursively(Stack<Integer> theStack, int radix) {
        if (theStack.empty()) {
            theStack.push(0);
            return;
        }
        // If the stack is empty and the digit is not a zero, push it back on.
        // If the stack is empty and the digit is a zero, then it is a leading
        // zero, so this case does nothing (and it just goes away).
        // If the stack is not empty, push the digit back unless it was
        // originally zero. In that case set it to radix - 1 and make a
        // recursive call to decrement the next digit.
        int digit = theStack.pop();
        if (digit == 0) {
            theStack.push(digit);
            return;
        }
        // If digit is less than (radix - 1), this decrementRecursively will
        // make a new call to itself. Otherwise, this decrements it and
        // pushes 0 on the stack.
        if (digit < radix - 1) {
            this.decrementRecursively(theStack, radix);
        } else {
            this.stackNum.push(digit);
        }
        // The stack is not empty, push the digit back unless it was originally zero.
        // In that case set it to radix - 1 and make a recursive call to decrement
        // the next digit.
        if (theStack.empty()) {
            theStack.push(0);
        } else {
            theStack.push(digit);
        }
    }

    // Remove a digit, and make a recursive call if there is more to
    // process. Use the 'toString' method of Integer to form the return string.
    // Simply as all digits concatenated together as strings.
    private String toStringRecursively(Stack<Integer> theStack) {
        String subString = this.toStringRecursively(theStack);
        if (!theStack.empty()) {
            subString = this.toBigInteger(digit)
            return subString + Integer.toString(digit);
        } else {
            subString = Integer.toString(digit);
            return subString;
        }
    }
}

// Constructor
public SlowBigNatural() {
    this.stackNum = new Stack<Integer>();
}

// Converting the value of the integer to a string.
public String toStringRecursively() {
    this.stackNum.push(0);
}

// Calls the SlowBigNatural(String numAsString) constructor, after
// converting the value of the BigInteger object "other" to a string.
public SlowBigNatural(BigInteger other) {
    this.stackNum = new Stack<Integer>();
    // Loop to iterate over the string, reading it character by character
    // into the stackNum table.
    for (int i = 0; i < numAsString.length(); i++) {
        int digit = Character.getNumericValue(numAsString.charAt(i));
        this.stackNum.push(digit);
    }
}

// Instantiate a stack of integers, this.stackNum = new Stack<Integer>();
// String numAsString
public SlowBigNatural(String numAsString) {
    this.stackNum = new Stack<Integer>();
    // Loop to iterate over the string, reading it character by character
    // into the stackNum table.
    for (int i = 0; i < numAsString.length(); i++) {
        int digit = Character.getNumericValue(numAsString.charAt(i));
        this.stackNum.push(digit);
    }
}

public void decrement() {
    // Call the local "helper" method decrementRecursively, passing in the stack
    // representation of the number and the radix. The local method has to
    // be separated due to Resolve convention.
    this.decrementRecursively(this.stackNum, this.RADIX);
    // If the stack comes back empty, push a 0 onto it.
    if (this.stackNum.empty()) {
        this.stackNum.push(0);
    }
}

public void increment() {
    // Call the local "helper" method incrementRecursively, passing in the stack
    // representation of the number and the radix. The local method has to
    // be separated due to Resolve convention.
    this.incrementRecursively(this.stackNum, this.RADIX);
}

public String toString() {
    // Call the local "helper" method toStringRecursively, passing in the stack
    // representation of the number. The local method has to be separated
    // due to Resolve convention.
    return this.toStringRecursively();
}
If you can imagine it, you can build it
(examples of student projects...)
School Spirit: O-H-I-O

Wouldn’t it be great if...
O-H-I-O App for iPhone/iPod

O-H-I-O! the iPhone App

Download Now

Hey Buckeyes, the "O-H-I-O!" app makes it easy to share your "O-H-I-O" photos taken anytime, anyplace. Share your Buckeye pride to become part of the phenomenon: From Paris to Killimanjaro, the Arctic Circle to Lane Avenue, thousands of Ohio State fans have already participated.

O-H!
Football Games in the ‘Shoe

Wouldn’t it be great if...
iShoe for Android and iPhone

demo
Big Data + Artificial Intelligence
Wouldn’t it be Great If...

- You could plan a trip by city bus?
- Playing marbles were fun?
- Rock-paper-scissors was fun???
Areas of Excellence at Ohio State and in Computer Science and Engineering
Excellence at Ohio State

- National prominence
  - 16th in public universities (USNWR '15)
  - 10th in total R&D expenditures
  - 2nd in industry-financed R&D
  - “Best Value Colleges” top 50 list (USAT ’11, Princeton Review ‘11)

- Freshman class ’18: 52,500 applications
  - 64% of freshmen from top 10% of HS class
  - Middle 50%: ACT 27-32 / SAT 1280-1410
    - Average: 29.3 / 1340 (30.8 / 1392 in Eng)
  - First-year retention: 95%
  - Graduation rate: 65% 4-year, 84% 6-year
Excellence in Engineering

- National prominence
  - 15th among publics (USNWR ‘15)
  - 13th overall according to recruiters (WSJ ‘10)
  - 11 members of National Academy of Eng.

- Employment opportunities
  - Sept. expo: 225 companies for engineers
  - 71% of students do co-op experience
Student Project Teams

Solar Decathlon

Buckeye Bullet
More Student Project Teams

EcoCar Challenge
More Student Project Teams...

Aerial Robotics
Baja Buckeyes
Environment. Design
ChemE Car
Concrete Canoe
Design/Build/Fly
Steele Bridge
Underwater Robotics

Engineers Without Borders
Community Service
EcoCar
Electric Motorcycle
FIRST Robotics
Formula Buckeyes
Solar Car

plus a dozen more...
CSE Student Organizations

Mobile App Club
Every Wednesday at 7:00pm
220 Caldwell Labs | The Ohio State University

Open Source Club
at The Ohio State University

ACM-W
Buckeye Hackers

plus a bunch more...
OHI/O Hackathon
Excellence at Computer Science

- 18th CS dept. among public universities in US (30th overall, USNWR 2018)
  - Steadily rising
  - Tripled research activity in last 10 years
  - Students 7th out of 110 teams at ACM Regionals

- Many faculty awards
  - Career, PECASE, PYI (32)
  - Fellows of IEEE, ACM, AAAI (13)

- Education awards for intro sequence
  - State: Ohio Faculty Innovator Award (2009)
  - Many university and college-level awards
Graphics

- Animation
- Scientific visualization
- Rendering
- Computational geometry, topology
Artificial Intelligence

- Machine learning
- Neural networks
- Speech processing
- Text analysis
- Vision and pattern recognition
Software Engineering

- Automatic verification
- Static analysis
- Testing
- Debugging
- Fault tolerance
- Comprehension
- Compiler optimizations
Networking

- Sensor systems
- Security
- Wireless, ad hoc
- Self-stabilization
High-Performance Systems

- Cluster-based computing
- Cloud and grid computing
- Massively parallel systems
- Databases
- Scientific computing
Doug Roble: A CSE Alum
Steve May: A CSE Alum
Ryan Geiss: A CSE Alum
Rebecca Fiebrink: A CSE Alum
Ben Gilbert: Future CSE Alum

SeizeTheDay
Some Things You Might Not Know about CS (at OSU)…
Classes are Small

- All CS classes capped at 40 students
- Honors classes capped at 25
- Frequent, flexible schedulings
Combine CS Major With...

- Entrepreneurship
  - Newpath = Entrepreneurship minor + Internships + Practicum

- Security
  - CAEIAE = National Center of Excellence in Information Assurance Education (DoD)

- Research
  - EUROPA = Undergrad Research Forum
  - Combined BS/MS degree

- Scholarships
  - University, College, Department
Choice of Degree Programs

Engineering (CSE)
- Computer science required – 22 hrs
- Pick list – 20 hrs
- Options – 8-15 hrs
- Other Engineering courses – 13 hrs
- ABET-accredited since 1999

Arts & Science (CIS)
- Computer science required – 22 hrs
- Pick list – 20 hrs
- Options – 8-15 hrs
- Semi-flexible requirements in natural & social sciences, foreign languages, etc.
Comparing Programs

Credit Hours

Degree Program

BS CSE

50
7
32
13
24

BS CIS

50
7
27
4
36

Computer Science
CS or Related Field
Other Math/Science
Other Engineering
General Education
# Sample Curriculum: CSE

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<thead>
<tr>
<th>Autumn (1st Semester)</th>
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</tr>
</thead>
<tbody>
<tr>
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<td>CSE 2221 Software I</td>
</tr>
<tr>
<td>Math 1151 Calculus I</td>
<td>Math 1172 Engineering Calculus II</td>
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<tr>
<td>Phys 1250 Physics I</td>
<td>Science</td>
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<td><em>Science: Bio, Chem, or Phys II</em></td>
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<tr>
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<td><em>Introduction to Engineering II</em></td>
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<td>Math 3345 Discrete Math: Logic</td>
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Comparing Programs

<table>
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<tr>
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<td>BS CSE</td>
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<td>BS CIS</td>
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- **Computer Science**: 50
- **CS or Related Field**: 7
- **Other Math/Science**: 32
- **Other Engineering**: 13
- **General Education**: 24
## Sample Curriculum: BA CIS

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Where do CS Grads go?

Google
facebook
Yahoo!
amazon.com
Intel
Apple
Microsoft
Carnegie Mellon University
University of Cambridge
Companies that Hire Our Grads

- **Computing**
  - Amazon, Google, Facebook, Expedia, Twitter
  - Apple, Microsoft, IBM, HP, Cisco, Intel, TI, NVIDIA

- **Financial**
  - Nationwide, JP Morgan Chase, Capital One, Fidelity, Liberty Mutual

- **Healthcare**
  - Cardinal, CoverMyMeds,

- **R&D, Defense**
  - GE, General Motors, Batelle
  - DoD, Air Force, Army, Harris, Lockheed Martin

- **Energy, Entertainment, ...**
  - Marathon, Muirfield, Bloomberg, Deloitte

- Placement: 75% industry (10% grad school)
## Salary Snapshot (Spring 2019)

### Degree Average Offer 75\(^{th}\) %

<table>
<thead>
<tr>
<th>Degree</th>
<th>Avg Offer</th>
<th>75(^{th}) %</th>
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</thead>
<tbody>
<tr>
<td>BS CSE/CIS</td>
<td>$73,701</td>
<td>$85,000</td>
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<tr>
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<td>($105,333)</td>
<td>($108,000)</td>
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<tr>
<td>MS CS</td>
<td>$86,667</td>
<td>$95,000</td>
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<td>($115,200)</td>
<td>($123,000)</td>
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<tr>
<td>PhD CS</td>
<td>$133,000</td>
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### Intern/Co-op Average Wage 75\(^{th}\) %

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<th>Intern/Co-op</th>
<th>Avg Wage</th>
<th>75(^{th}) %</th>
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</thead>
<tbody>
<tr>
<td>BS CSE/CIS</td>
<td>19.58 $/hr</td>
<td>23.00 $/hr</td>
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<tr>
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<td>(36.10 $/hr)</td>
<td>(42.68 $/hr)</td>
</tr>
<tr>
<td>MS CS</td>
<td>18.50 $/hr</td>
<td>(50.00) $/hr</td>
</tr>
<tr>
<td></td>
<td>(49.94 $/hr)</td>
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</tr>
</tbody>
</table>

From: [https://ecs.osu.edu/statistics/salaries-wages](https://ecs.osu.edu/statistics/salaries-wages) (viewed on 10/18/2019)
## UG Participation in Study Abroad

The Ohio State University is ranked 7th in the nation for undergraduate participation in study abroad programs, according to the 2018 Open Doors Report, Inst. Internat. Education.

<table>
<thead>
<tr>
<th>College</th>
<th>Count</th>
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<tbody>
<tr>
<td>Arts and Sciences</td>
<td>998</td>
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<tr>
<td>Business</td>
<td>553</td>
</tr>
<tr>
<td>Engineering</td>
<td>238</td>
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<tr>
<td>Education and Human Ecology</td>
<td>139</td>
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<tr>
<td>Agriculture</td>
<td>125</td>
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<tr>
<td>Architecture</td>
<td>87</td>
</tr>
<tr>
<td>Environment and Natural Resources</td>
<td>84</td>
</tr>
<tr>
<td>Health and Rehabilitation Sciences</td>
<td>75</td>
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<tr>
<td>Public Health</td>
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<tr>
<td>Nursing</td>
<td>32</td>
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<tr>
<td>Public Affairs</td>
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<tr>
<td>Pharmacy</td>
<td>29</td>
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<tr>
<td>Exploration</td>
<td>28</td>
</tr>
<tr>
<td>Social Work</td>
<td>22</td>
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<tr>
<td>Undergraduate Medical Education</td>
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<tr>
<td>Nondegree</td>
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<tr>
<td>Agricultural Technical Institute</td>
<td>7</td>
</tr>
<tr>
<td>Visiting Students</td>
<td>1</td>
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<tr>
<td>Dental Hygiene</td>
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</table>

Total: 2,509
Top 10 Destinations

<table>
<thead>
<tr>
<th>Country</th>
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<tbody>
<tr>
<td>Multiple</td>
<td>460</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>372</td>
</tr>
<tr>
<td>Spain</td>
<td>206</td>
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<tr>
<td>Italy</td>
<td>170</td>
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<tr>
<td>Brazil</td>
<td>133</td>
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<tr>
<td>Canada</td>
<td>126</td>
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<tr>
<td>Costa Rica</td>
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<tr>
<td>Japan</td>
<td>94</td>
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<tr>
<td>Australia</td>
<td>84</td>
</tr>
<tr>
<td>Ghana</td>
<td>83</td>
</tr>
</tbody>
</table>
“Best Jobs in America” Surveys

- **Software Engineer**, 2012
- **Software Engineer**, 2011
  
  From: [http://www.careercast.com/jobs-rated](http://www.careercast.com/jobs-rated)

- **Software Developer**, 2011
- **Software Architect**, 2010
- **IT Systems Engineer**, 2009
- **Software Engineer**, 2006

Future Job Prospects

Average Annual Engineering Job Openings, 2008-2018 (BLS Projections by Discipline)

CS is Collaborative

Team meeting of computer scientists at Googleplex
Summary

- CS is everywhere; changing our world
- CS is “imagineering”
- Choice of degree programs: CSE & CIS
- Job prospects are excellent
Computer Science & Engineering

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