K-12 Computer Science Across Alabama

Jeff Gray, Ph.D. - Professor

Carnegie Foundation Professor of the Year (Alabama, 2008)
ACM Distinguished Educator

Co-Chair, Governor Kay Ivey's K-12 CS Advisory Board

University of Alabama

Department of Computer Science

gray@cs.ua.edu

http://gray.cs.ua.edu

"The greatest tragedy I know of is that so **many young people never discover what they truly want to do**."

Edna Kerr

(as quoted by Dale Carnegie, "How to Stop Worrying and Start Living")

Why do we need to expand K-12 CS in Alabama?

Google Breaks Ground on $600M Alabama Data Center
June 5, 2018

TECH • FACEBOOK
Facebook Is Building a $750 Million Data Center in Huntsville, Alabama
By EMILY PRICE June 15, 2018

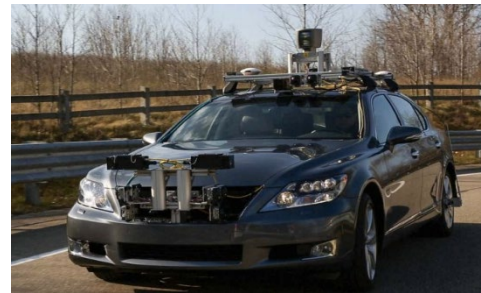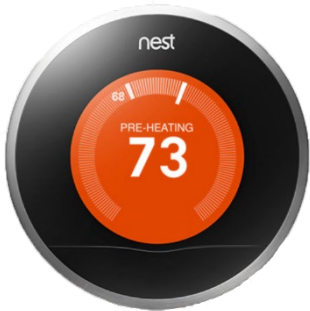

Shipt unveils plan to keep HQ in Birmingham, add 881 jobs
By Ty West and Tyler Patchen – Birmingham Business Journal
Jul 12, 2018, 12:07pm CDT Updated Jul 12, 2018, 1:08pm

Software is Everywhere

- Software is in many places other than traditional desktop or laptop computers
    - Automobiles, airplanes, televisions, copiers, razors…

- These devices also need software and often require strong technical skills to develop
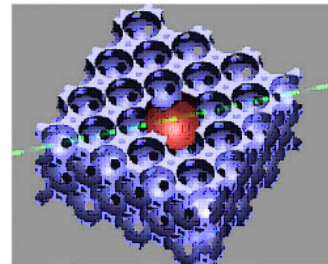
Intellectual Opportunities

"… the software industry is going to make more breakthroughs in these next 10 years than it's made in the last 30 … software is really going to transform not just what we think about as the computer industry, but the way that everything is done …"
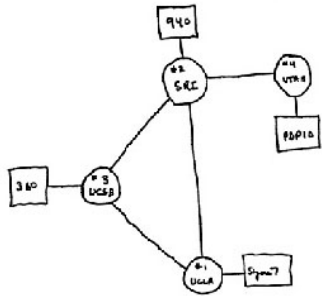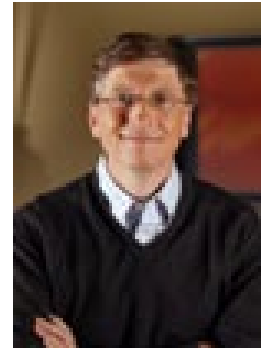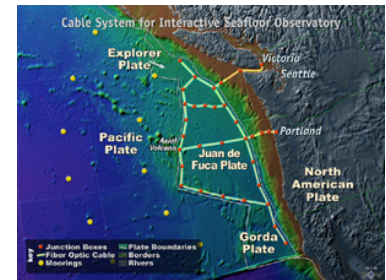

Re-architecting the Internet

Wreckless driving

Quantum computing
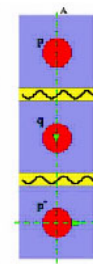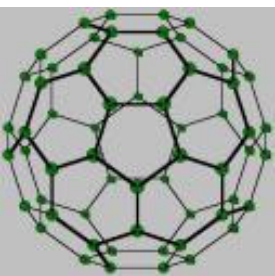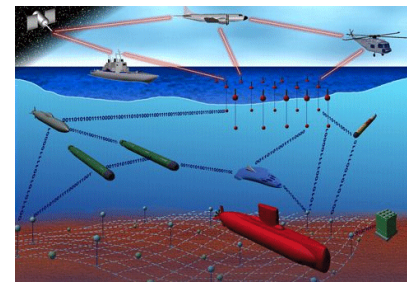

Transforming all fields of science and engineering

Harnessing parallelism

Prosthetics / augmentation / access

Transforming the nation's defense

CS Changes Everything

IT'S CHANGING EVERYTHING.

- "CS Changes Everything"
  - http://bit.ly/cs-changes
- New Alabama-focused video with APTV and HudsonAlpha
  - http://bit.ly/cs-hudsonalpha

Learn computer science.
It's changing everything.

The Demand for Computer Scientists

CNN Money
A Service of CNN, Fortune & Money

Best jobs in fast-growth fields
If you're stalled or burned out, try one of these high-growth sectors where you can earn more, get ahead and put life back into your career. More

1. Software Developer
2. Physical Therapist
3. Financial Adviser
4. Civil Engineer
5. Marketing Specialist
6. Management Consultant
7. Information Technology Consultant
8. Database Administrator
9. Financial Analyst
10. Environmental Engineer

COMPUTERWORLD

IT jobs will grow 22% through 2020, says U.S.
Biennial update says offshoring will limit growth in some occupations, while healthcare IT provides a boost

BEST JOBS U.S.News RANKINGS

U.S. News Best Jobs
Software developer takes the number one spot.

Here are the top 10 jobs:

1. Software Developer   2. Computer Systems Analyst   9. Web Developer

The Top Skills of 2016 on LinkedIn United States

1 Cloud and Distributed Computing	0	6 Network and Information Security	-2
2 Statistical Analysis and Data Mining	0	7 Middleware and Integration Software	-2
3 Mobile Development	0	8 Web Architecture and Development Framework	+2
4 Storage Systems and Management	+2	9 Algorithm Design	-1
5 User Interface Design	+2	10 Java Development	-1

Top Jobs in Alabama

AL.com, June 2017: http://bit.ly/top-al-jobs

Alabama's most high demand jobs ranked

Updated June 12, 2017
Posted June 12, 2017

Software developers, applications

Average annual growth: 1.78 percent

Average job openings: 165

Average salary: $93,782

Computer systems analysts

Average annual growth: 2.17

Average job openings: 160

Average salary: $80,610

Software developers, systems software

Average annual growth: 1.83 percent

Average job openings: 150

Average salary: $100,645

The Potential for Alabama

- Per capita, Huntsville is one of the top five cities in the US with concentration of software developers, and #4 in overall STEM workers.

- Cummings Research Park is the second largest in the United States and the fourth largest in the World.

Alabama city is America's fastest-growing tech town

Updated June 8, 2017 at 1:39 PM; Posted June 8, 2017 at 1:23 PM

http://bit.ly/top-tech-cities

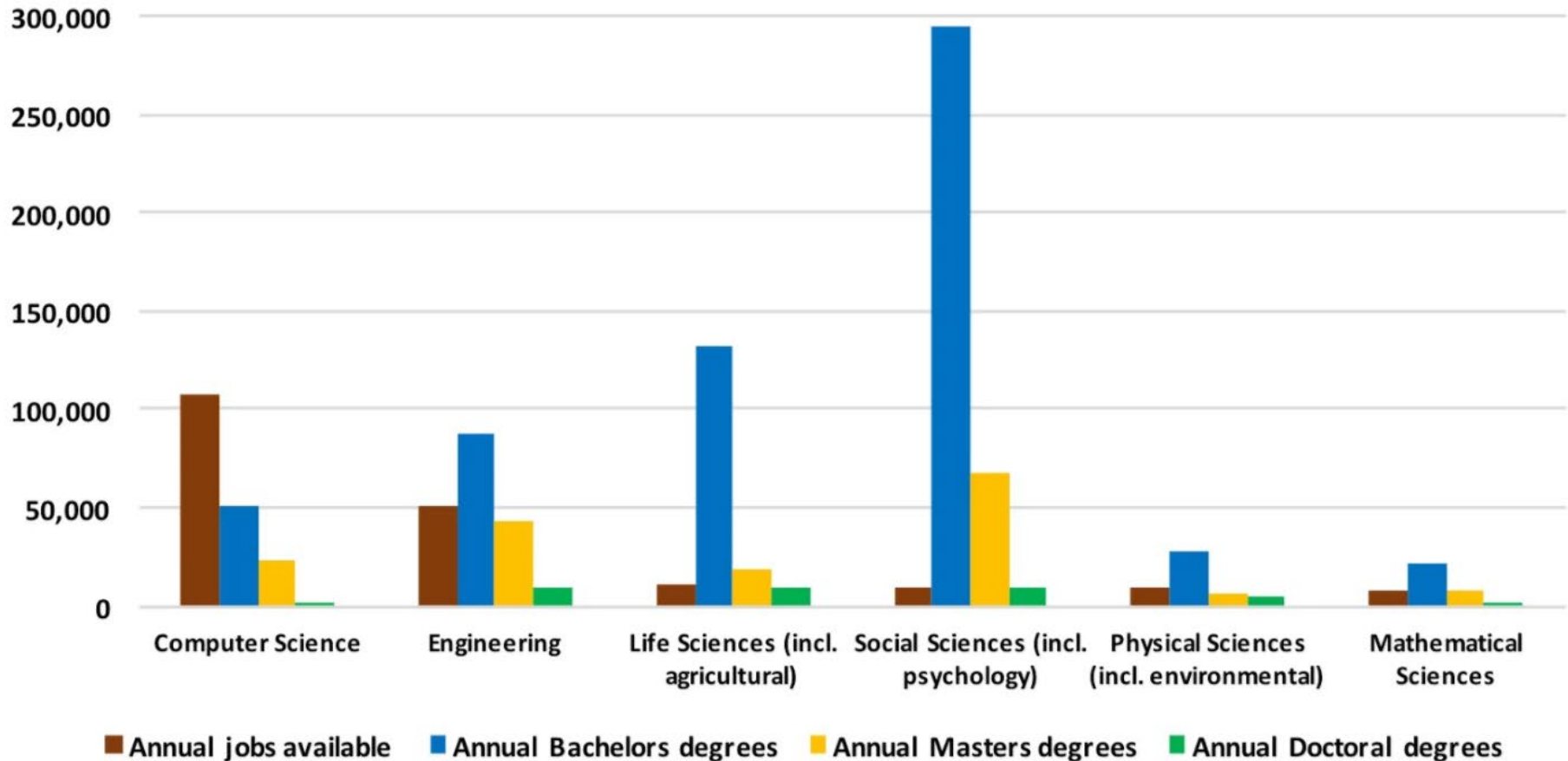ZipRecruiter's top 10 tech jobs and cities are as below:

1. **Huntsville** - 309 percent tech job growth
2. **Thousand Oaks, Calif.** - 200 percent
3. **Phoenix** - 188 percent
4. **Albany, N.Y.** - 161 percent
5. **Kansas City** - 157 percent
6. **Orlando** - 149 percent
7. **Salt Lake City** - 117 percent
8. **Nashville** - 114 percent
9. **Jacksonville, Fla.** - 111 percent
10. **Baltimore** - 109 percent

Where the STEM Jobs Will Be

Degrees vs. Jobs Annually

Annual jobs available vs. degrees granted

Legend: Annual jobs available | Annual Bachelors degrees | Annual Masters degrees | Annual Doctoral degrees

Categories: Computer Science | Engineering | Life Sciences (incl. agricultural) | Social Sciences (incl. psychology) | Physical Sciences (incl. environmental) | Mathematical Sciences

BLS job projection data: http://www.bls.gov/emp/ind-occ-matrix/occupation.xlsx
S&E Indicators degree data: http://www.nsf.gov/statistics/2016/nsb20161/uploads/1/12/at02-01.xlsx

Where the STEM Jobs Are (and Where They Aren't)

By STEVE LOHR   NOV. 1, 2017

Life Sciences*
183k
12k

Engineering
169k
51k

Physical Sciences
43k
9k

Mathematical Sciences
33k
7k

Computer Science
107k
108k

So Many Degrees, So Little Demand

The number of **graduates** with technical majors (shown: bachelor, master and Ph.D. degrees awarded in 2015-16) tends to outpace **job openings** (shown: 2014-24 projections, annualized). Computer science is the exception.

http://bit.ly/stem-jobs

The Demand for Computer Scientists

- University of Alabama CS Undergrads
  - Job Placement: 91%
  - Starting Salary Offers

Average Starting Salary	Median Starting Salary	Salary Range
$71,286	$62,500	$52,000-$106,000

- National Job Outlook
  - According to the National Association of Colleges and Employers (NACE)
    - Computer Science tops list of best major for jobs with the <u>highest number of job offers per major</u> (2.8 job offers per CS undergrad)

CS4Alabama

Every student in Alabama should have the opportunity to learn Computer Science!

Exciting Time in Alabama for K-12 Computer Science!

- **National**
  - Federal Department of Education EIR grants supporting over $200M in CS/STEM PD
  - CS is the really cool new kid on the block!
- **State Activities in K-12 CS**
  - CS Standards completed
  - New Superintendent Dr. Eric Mackey mentions CS in his interview
  - Governor Ivey names CS as top-3 education goals!
  - New Governor's CS Task Force
    - April 2019 – Governor's CS Summit
  - Governor Ivey Joins GovernorsForCS
    - Commitment to standards, funding, and CS in every high school
 - New $1.5 state funding for teacher PD!
- **Local**
  - Many exciting events happening in your local schools!

Governor Kay Ivey's CS Advisory Council

- First Meeting October 18, 2017
- To bring various stakeholders together to:
  - Analyze and discuss the current state of computer science in Alabama
  - Develop a plan for forming and sharing recommendations
  - Help remove silos and make all aware of CS multiple efforts statewide
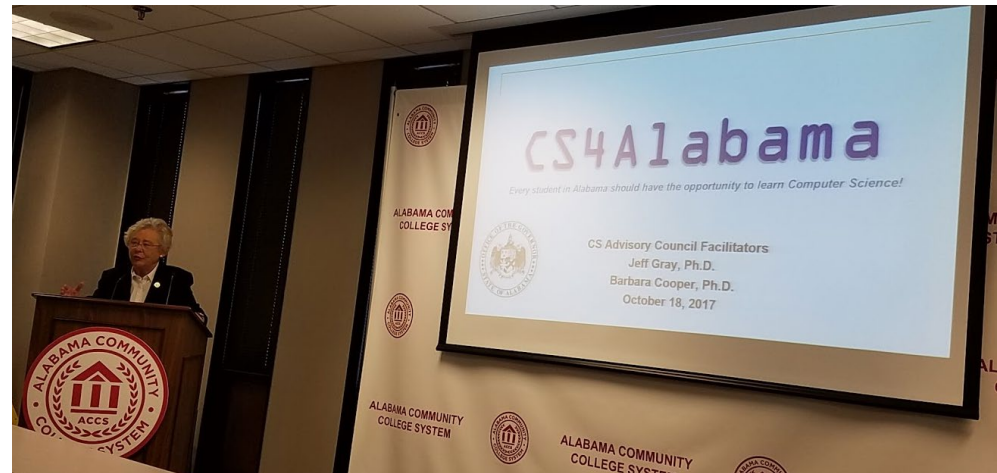
Alabama Digital Literacy and Computer Science Course of Study Standards

- Committee formed in early spring 2017, with monthly meetings, with the task to create an updated course of study
- Draft standards for public comment released November 1, 2017
- March 8, 2018: Stand~~ard~~s ~~approv~~ed by the State BoE

Alabama is 15th state to pass standards for Computer Science!

Available at:
http://bit.ly/al-dlcs-standards
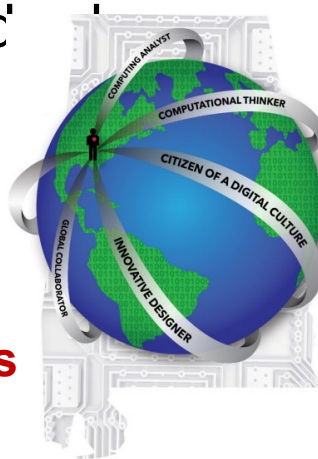
AP CSP in Alabama – Leading the nation!

- AP CSP and AP CS A results from May 2017

	Total Exams	Female	African-American	% Qualify for AP Credit
New AP CSP	1399	457 (33%)	160 (11%)	65%
AP CS A	304	56 (18%)	15 (5%)	52%

- 27 exams in 2007 compared to 1,703 exams in 2017
- African-American % seems low for CSP, but Alabama may lead the nation in this metric (will know soon)
- With additional teachers being trained, we expect the number of exams taken to increase further in May 2018
- AP CSP is College Board's largest first-time exam

May 2017 – Alabama and AP CSP Participation

Per Capita, Alabama was ranked 2nd
nationally in AP CSP exams taken

The map below shows the number of AP CSP exams
per 100,000 of population.
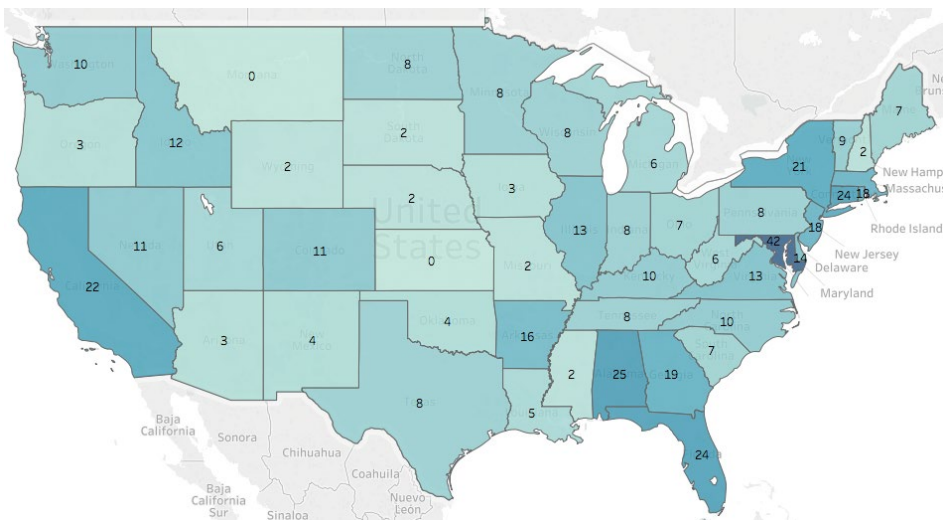
§The states with the highest number of AP CSP exams per 100,000 of population were:

pos	state	number of exams per 100,000 of population
1	Maryland	42.8
2	Alabama	25.9
3	Florida	24.9
4	Connecticut	24.7
5	California	22.5
6	New York	21.9
7	Georgia	19.5
8	Massachusetts	18.7
9	New Jersey	18.5
10	Rhode Island	18.2

May 2017 – Alabama and AP CSP Participation

Per Capita, Alabama was ranked 3nd nationally in AP CSP exams taken by African American students

Per Capita, Alabama was ranked 3nd nationally in AP CSP exams taken by African American **FEMALE** students

Pos	State	# AA Students	Population	#exams/100,000
1	Maryland	360	5884563	6.117701518
2	District of Columbia	31	632323	4.902557712
3	Alabama	143	4822023	2.965560305
4	Florida	459	19317568	2.376075498
5	Massachusetts	151	6646144	2.271994107
6	New York	437	19570261	2.232979928
7	Georgia	186	9919945	1.875010396
8	Tennessee	116	6456243	1.796710564
9	Arkansas	49	2949131	1.66150639
10	Connecticut	51	3590347	1.420475514

| Pos	State	# AA Female Students	Population	#exams/100,000
1	Maryland	150	5884563	2.549042
2	District of Columbia	12	632323	1.897764
3	Alabama	56	4822023	1.161338
4	Massachusetts	72	6646144	1.083335
5	New York	197	19570261	1.006629
6	Tennessee	56	6456243	0.867378
7	Florida	148	19317568	0.766142
8	Arkansas	22	2949131	0.745982
9	Georgia	68	9919945	0.685488
10	Louisiana	30	4601893	0.651906

AP Computer Science

Alabama

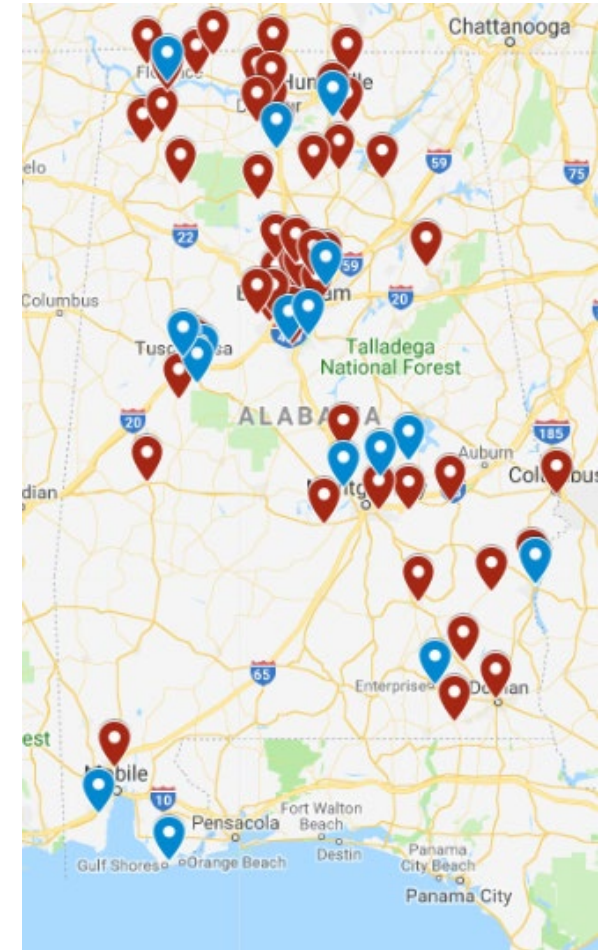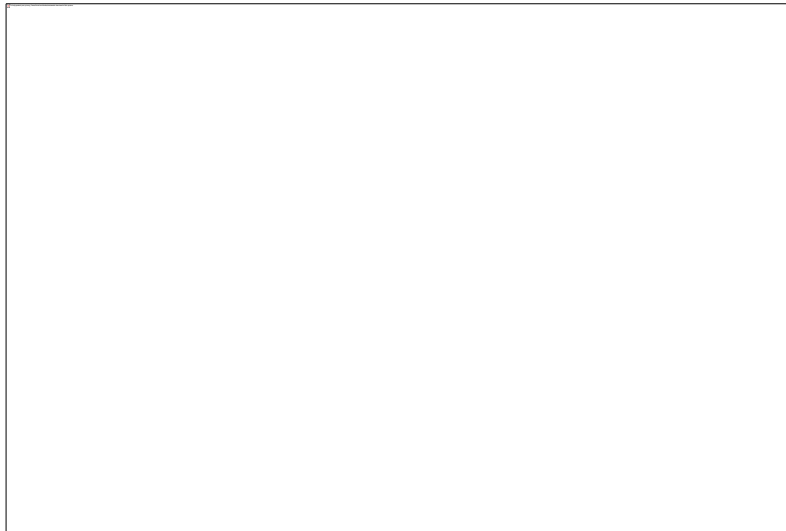|	2008	2017	2018
APCS Test Takers	39	1403	2017
APCS Qualifying Scores	30	861	1118
White	26	1230	1865
Hispanic	0	70	119
Black	3	155	245
Asian	9	165	190
Male	*	983	1375
Female	*	419	642

K-5 Code.org Fundamentals

- Code.org
  - Trained over 1,800 K5 teachers in 9 states (over 1,400 from Alabama) through over 70 workshops
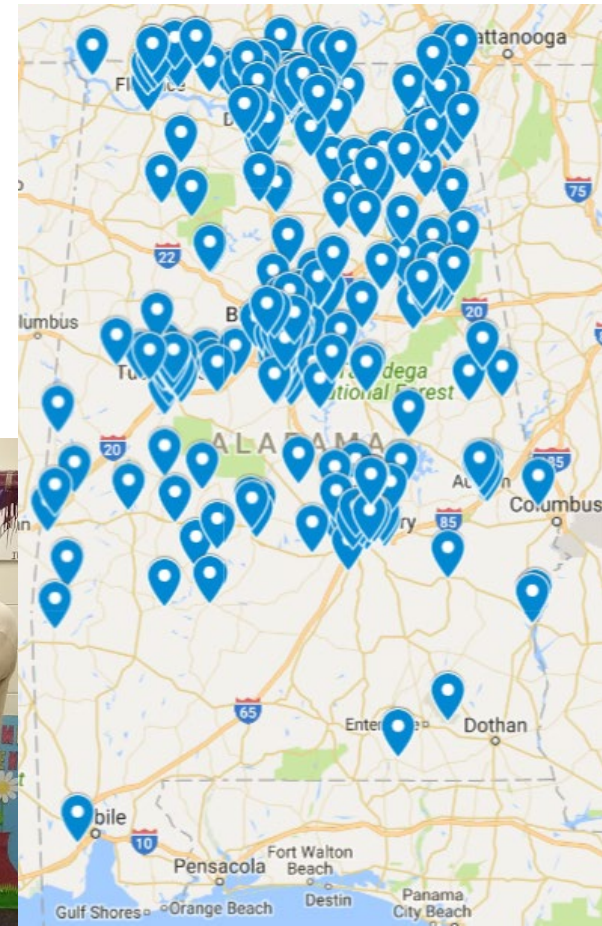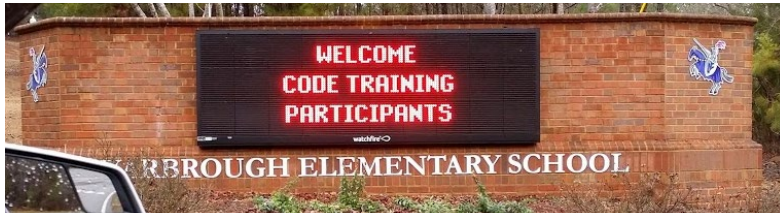
# Code.org CS Discoveries – Middle School

- Code.org CSD led by A+ College Ready
- Year-long authentic CS course
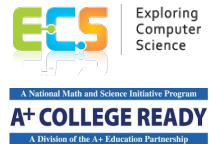- 2017: 18 schools
- 2018: 55 schools

CS4Alabama Map

📍 NSF Cohort 1 (8): 2013-2016   📍 Code.org Cohort 4 (23): 2016-2017

📍 NSF Cohort 2 (20): 2014-2016   📍 Code.org Cohort 5 (21): 2017-2018

📍 NSF Cohort 3 (21): 2015-2016   Additional 5 PLTW CSP Teachers (not shown)

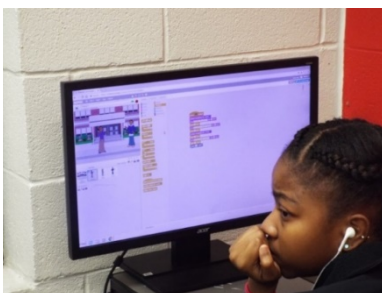49 NSF CE21 Trained Teachers
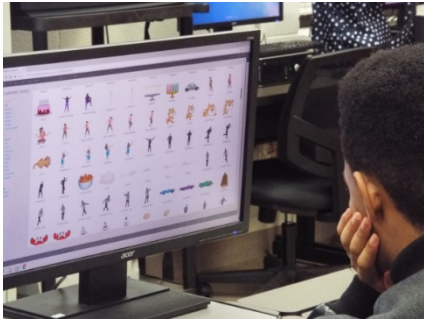
October 2017: Alabama CS Teachers Summit
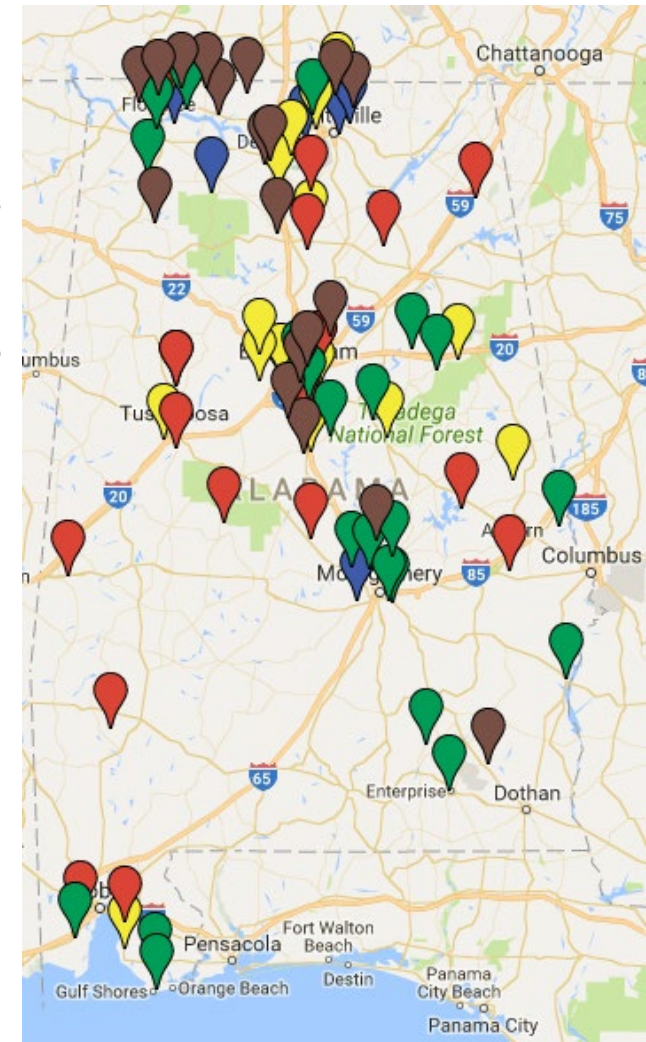
ECS4Alabama

Quarterly Meeting

Tuskegee University

October 2, 2018

ECS4Alabama: Progress

Cohort I 📍   Cohort II 📍

- 24 Teachers

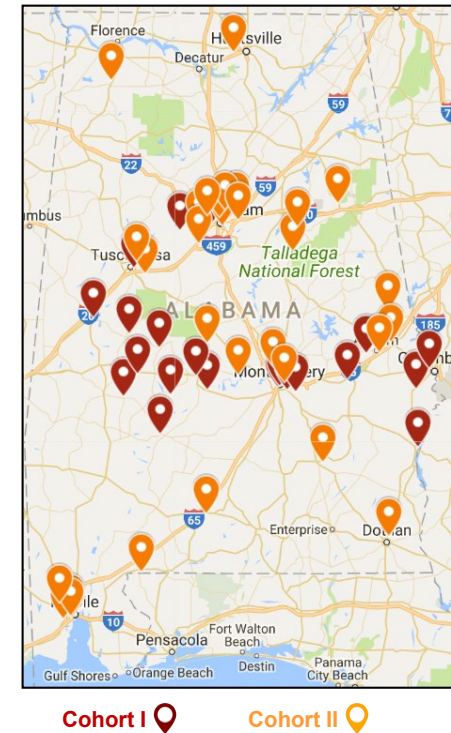| Semester	# Teachers	# Sections	# Students	% Minority	% Female
FA 2017	23	37	587	83%	47%
SP 2018	23	36	528	78%	50%

- 52 Teachers

Semester	# Teachers	# Sections	# Students	% Minority	% Female
FA 2018	43	59	932	80%	42%

Former Alabama Mathematics Course of Study

- 2015 Discrete Mathematics Course
  - http://bit.ly/al-discrete-2015
    - 3) Use the recursive process and difference equations to create fractals
    - 4) Convert between base ten and other bases.
    - 8) Apply algorithms, including Kruskal's and Prim's, relating to minimum weight spanning trees, networks, flows…
      - a. Use shortest path techniques to find optimal shipping routes.
    - 9) Determine a minimum project time using algorithms to schedule tasks in order, including critical path analysis, the list-processing algorithm, and student-created algorithms.

New Alabama Mathematics Course of Study

- 2019 Finite Mathematics Course
  - Voted on this month
  - Topics include
    - Apply ciphers and understand the mathematics of public and private crytopsytems (modular arithmetic and RSA public key cryptography)
    - Mathematics of error correction codes
    - Apply methods of data compression (Huffman codes)
    - Similar topics from discrete math in network and graph analysis algorithms (Shortest Path)
    - Recursive definitions (fractals, number sequences)
    - Logical reasoning (truth tables)

# AP Computer Science Counts as Math Graduation Credit

- AP CSP and AP CSA
  - Since 2013, count as math graduation elective
  - However, don't skip Calculus if you want to major in Engineering or Science
  - More info
    - http://gray.cs.ua.edu/pubs/sigcse-2015-math.pdf

A Case Study on Adding Computer Science as a Math Graduation Elective: A Report from the Alabama CS/Mathematics Crosswalk Committee
Jeff Gray, Mary Boehm, Carol, Crawford, Jeff Baker, Gina McCarley, Kitty Morgan, Kelley Rouze, Jill Westerlund, and Carol Yarbrough, *ACM Technical Symposium on Computer Science Education (SIGCSE)*, Kansas City, MO, March 2015.

K-12 Outreach at UA CS (Students)

Mentoring for Science Fair Competitions
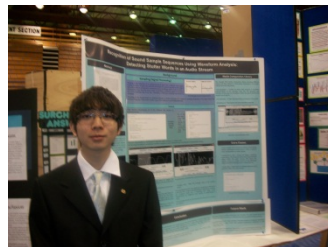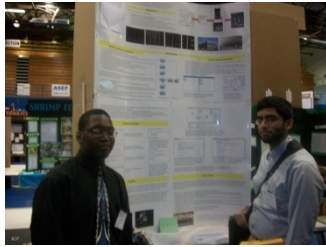
- Mentoring throughout academic year; students treated like a PhD student with office space
- Since 2010, 7 students named ISEF finalists

NCWIT Aspirations in Computing

- Hosted the NCWIT Aspirations in Computing banquet, which honors over 50 high school girls each year
  http://bit.ly/ncwit-alabama

Summer Camps

- Summer: Java, robots, Android!
- Summer: Teacher workshops
- Summer: Middle school camps
- Taught by UA Faculty
  http://outreach.cs.ua.edu/camps

Alabama Robotics Contest

http://outreach.cs.ua.edu/robotics-contest/

- 3-hour contest; solve 3 challenge problems
- Open to all grades in K-12; statewide
- Open platform
- Focus on programming

Comments or Questions?