Workshop Title: Enhancing Computer Science Education (CSE) with the Use of 3D Printer Technology

Presenters:

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Abstract: This workshop provides an introduction to three-dimensional (3D) printing. This tutorial will: cover the general background of 3D printing, summarize popular software tools, describe associated challenges and offer suggestions for application within computer science (CS) coursework. Attendees will get hands-on experience with 3D printing tools and will be able to print a limited number of items during the workshop. Participants will perform a full life cycle exercise in the printing workflow, progressing from a concept, to a digital model, to a physical implementation. The workshop will also describe the authors' experience integrating this authentic learning into several IT and CS courses. Experience gained will be useful after the session in both printer and printer-less environments. (Participant Laptop Recommended)

Intended audience: Late secondary and early post-secondary CS and IT educators teaching survey, programming and digital media classes.

Presenter Biographies:

Robert Lutz is an assistant professor of information technology. He received an undergraduate degree in mechanical engineering, a master in business administration and his doctorate in information systems. Prior to joining GGC, he taught multiple information technology topics in both academic and commercial settings. He has considerable IT industry experience. His primary academic interests include gadgets, human computer interaction, software engineering, cloud computing and ubiquitous computing.

Evelyn Brannock is an assistant professor of information technology. Her primary interests include digital signal processing, with an emphasis on the discrete wavelet transform, data security, especially in the area of watermarking, bioinformatics, software engineering and model driven architecture (MDA). She has over two decades of industry experience.

Each presenter previously led a version of this workshop at another conference. The strategies that will be shared have been successfully deployed in multiple course offerings at their institution.

Materials provided: Each participant receives (1) an electronic copy of lecture materials, (2) step by step instructions for the exercises utilized in the session (3) hands-on access to a 3D printer (4) example student assignments, and (5) instructions on where to acquire sample parts for use in class like those used in the workshop.

Rough Agenda:

1. **General Background of 3D Printing** (approximately 45 minutes)
   - History, nomenclature (infills, rafts, supports, bridges and plates), concepts, G-Code language, types of machines and materials
   - The 3D printing workflow and ecosystem
2. **Challenges with 3D Printing (**approximately 20 Minutes)
   - Printing times, parts that will not adhere to the print surface, parts that will not fit together, parts that fail, small parts, consumer readiness (400 degrees?, UL approved!?), bricking

your printing
- Calibration, calibration, calibration
- Space for machine(s) and setup

3. Tools (approximately **30 Minutes)**
- Processing environments, slicing software, modeling tools (Blender, Autodesk Inventor, Google SketchUp, TinkerCAD, Autodesk's 123d Catch, 123d Creature,123d Make), open source tools, Raspberry Pi 3D print server

4 3D Printing in CS and IT Education (approximately 30 Minutes)
- 3D printing is a hands-on and engaging active learning topic: students really love this topic!
- Things that can be prepared ahead of time
- Application in and Programming Courses
  - Writing code that writes code, short-circuiting the traditional workflow with purpose-built software, programming the straight skeleton algorithms, infill generation algorithms
- In IT/CS Survey Courses and Digital Media Courses
  - Create video documentaries of 3D printing projects, build and use a DIY scanner, create models with photogrammetric processing, create time lapse videos of 3D build, discuss 3D printed guns, discuss crowdsourcing, pass around fabricated parts
- How to get started with a modest system or service
- Suggestions for initial projects and demonstrations

5. In the Workshop (approximately 40 Minutes)
- Inspect interesting 3D printed parts
- Build simple CAD models
- Download models from online services
- Download and run open source slicer and visualizer onto your own laptop

Note: A 3D printer will be available during the session to make a small number of parts and to demonstrate the 3D printing process. For attendees not able to print their parts during the session, interested attendees can complete the process inexpensively with an online printing service after the workshop. (This mirrors what can be accomplished with students in IT classes).

Audio/Visual and Computer requirements: A Mac or Windows laptop with internet access capability is recommended for participants. Presenters will need a digital projector. Power and table space is required for the 3D printer and print server (printer and print server to be supplied by the presenters).

Laptop Recommended: all participants should bring a laptop, but could collaborate.

Space and Enrollment restrictions: The workshop is designed to handle up to 30 people as long as sufficient seating, power and internet are provided. The printer table needs to be 6' long, or more. The printer and print server must have access to power.

Other critical information: The workshop will be revised based on feedback from a previous offering at SIGITE 2013. Therefore, we anticipate a valuable workshop experience.