

Lecture #24 – Intellectual Property

ESE1500 Spring 2023
Slides 2018–2023 DeHon

**ESE 1500 –
DIGITAL AUDIO BASICS**



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PRECLASS

- × **Cost to develop and write a book?**
 - + 200 days @ \$500/day
- × **Cost per book (assume \$1 to print book)**
 - + Total volume 1
 - + Total volume 10,000
 - + Total volume 1 million
- × **Book sells \$10**
 - + Value added by writer?
 - + Copies sold for author to break even at \$2/copy to writer?

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ECONOMIC TERMS

- × **Production cost** – expense to produce
- × **Price** – what consume will pay for it
 - + Value to consumer
- × **Profit = Price – cost**

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OBSERVE

- × **Creative / Intellectual work produces most of value**
- × **At least in volume, physical costs of reproduction is small part of product price**

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PRECLASS CONTINUED

- × **Cost to photocopy 200 page book at \$0.05/page?**
- × **Cost to scan book at 10page/minute?**
- × **Cost to perform a 10s copy onto flash drive?**
- × **Cost of portion of flash drive used**
 - + \$4 for 32GB drive, 0.5MB file

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OBSERVE

- × **With digital representation**
 - + Cost of "physical" reproduction trends to 0

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PAST

- × **Much of value in physical construction of objects**
 - + Bridge, house, car, screwdriver
- × **Expensive to reproduce / copy**
- × **Reproductions imperfect**
 - + 5th generation analog recording
 - + 4th generation photocopy of text
- × **Inherent barrier to making copies**
 - + Value to buying original

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DIGITAL REPRESENTATION

- × **Can represent perfectly in bits**
 - + Including sound, words
- × **Can make perfect copies**
- × **Bits are cheap...and getting cheaper**
 - + Copying "free"
- × **Intellectual value disconnected from physical reproduction**

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WHAT ELSE HAS THIS PROPERTY?

Digital Intellectual Property	Physical IP Renderer
Novel	eReader
Song (MP3)	MP3 Player
JPEG Photo	
	Video Player
Video Game	
	Arduino or Personal Computer
Verilog digital circuit	
STL (3D CAD drawing)	
DNA Sequence	DNA Printer

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INTELLECTUAL PROPERTY

- × **Intangible creations of human intellect**
- × **Have value**
- × **Don't necessarily have physical embodiment on their own**

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INTELLECTUAL PROPERTY CREATORS

- × **As Engineers**
 - + Program, develop algorithms, design circuits
- × **Almost everything we create will have this property**
 - + Value added is intellectual
 - + Can be represented digitally in bits
 - + Can (increasingly) be copied/reproduced cheaply
- × **Easy to have impact**
 - + Our solutions can reach millions, billions
 - + Decreasing physical barriers to propagation of solutions
- × **Challenge to protect and reward IP creators**

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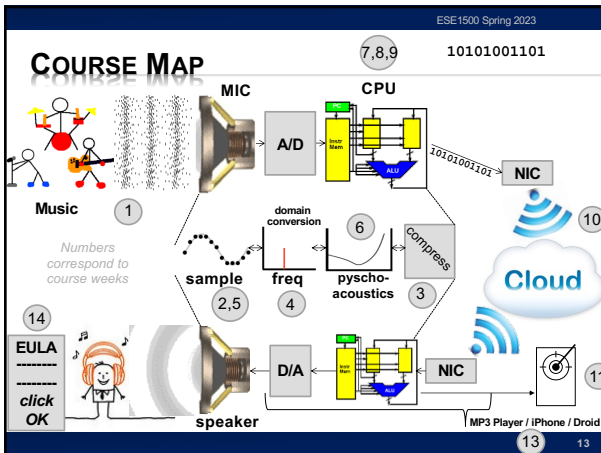
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OUTLINE

- × **Setup Need / Opportunity – What is IP**
- × **Where are we**
- × **Rationale for IP Protection – Why Protect**
- × **How protect?**
 - + Patents
 - + Copyrights
 - + Open Source
 - + NDA
 - + Licensing

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ESE

Part 2
RATIONALE

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PRICING CHALLENGE

- × **When cost of copying $\rightarrow 0$**
 - + Inventor/author must recover development cost
 - Price must include develop cost + copy cost
 - + Copier does not have development cost
 - Price = copy cost + epsilon
 - Competition of copiers will drive epsilon down near 0
 - + Inventor/author not compensated for development
 - Remove incentive/reward for development
- × **Demand: developers need way to exclude others from copying to incentivize creation**

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ARROW'S INFORMATION PARADOX

- × **Customer not know how to value information until see information (see details of product)**
 - + Enough information to decide to buy
 - + Enough information to decide what will pay for it
- × **Once show customer information, sufficient detail, they have enough information to reproduce**
 - + Could walk away and produce their own without paying for it
- × **Disclosure of what effectively transfers technology**
- × **Demand: protection for developer**
 - Arrow, Kenneth J. Economic Welfare and the Allocation of Resources for Invention, in *The Rate and Direction of Inventive Activity*, 609 (Nat'l Bureau of Econ. Research ed. 1962).

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BALANCE INDIVIDUAL AND SOCIETAL GOOD

- × **Individual should benefit from their own effort**
- × **Society advances with the accumulation of knowledge**

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INTERLUDE: NIL
NIKOLAI IVANOVICH LOBACHEVSKY

<https://www.youtube.com/watch?v=gXifXirQF3A>

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BEFORE COPYING WAS AN ISSUE

- × **Concern that new developments/ideas would be lost when inventor die**
 - + Techniques could remain secret for decades!
- × **Incentive to make inventions known**
 - + Advance the general welfare

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US CONSTITUTION

- × **Article 1, Section 8, Clause 8:**
 - + To promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries

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MECHANISMS (TO SUPPORT)

- × **Patents**
 - + Cover inventions
 - + E.g., Flying Machine (US 821,393), ENIAC (US 3,120,606),
- × **Copyrights**
 - + Creative expression
 - + E.g., novel, song, movie

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MECHANISMS FOR PROTECTION

- × **Messy and imperfect**
- × **Haven't kept up with technology**
- × **Likely need (and will need) innovation and refinement**

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Part 3

MECHANISMS

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PATENT

- × **Inventions**
- × **Non-obvious to one "ordinary skill in art"**
- × **Reduced to practice**
- × **Cannot patent**
 - + Abstract ideas
 - + Laws of nature
- × **US: First to file**
 - + (prior to 2013 was first to invent)
- × **Exclusive rights 20 years from filing**

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WHAT MIGHT BE TRICKY / NON-SATISFYING?

- ✗ **First to file? (even invent?)**
- ✗ **20 year term?**

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PATENT

- ✗ **Identification of problem is part of invention**
- ✗ **Claims**
 - + Define the invention
 - + Technical coverage
- ✗ **Requires disclosure**
 - + If really believe no one else will figure it out...or can copy it, may be better to keep as a *trade secret*
- ✗ **License to litigate**
 - + Recover damages through litigation
 - + Establish violation
 - + Validity of many patents overturned in litigation

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PATENT PROCESS

- ✗ **US have one year from first-public disclosure to file**
 - + Many places – public disclosure prevents patent
 - + <https://www.uspto.gov/web/offices/pac/mpep/s2153.html>
- ✗ **May file provisional patent to get filing date**
- ✗ **File patent with claims**
- ✗ **Reviewed by examiner**
- ✗ **Examiner reports on what may be allowable**
 - + As-is
 - + With tighter qualifications
 - + Not-at-all
 - + On a per-claim basis
- ✗ **Typically requires several iterations**
- ✗ **Often year(s) before patent issues**
- ✗ **Filing costs thousands of dollars**
 - + With lawyer/legal fees tens to hundreds of thousands

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US10725778B1

(12) **United States Patent** (16) Patent No.: **US 10,725,778 B2**
 Defton et al. (45) Date of Patent: **Jul. 28, 2020**

(54) PROCESSING METADATA, POLICIES, AND COMPOSITE TAGS

(71) Applicant: **The Charles Stark Draper Laboratory, Inc., Cambridge, MA (US); The Trustees of the University of Pennsylvania Penn Center for Innovation, Philadelphia, PA (US)**

(72) Inventors: **Andre Defton, Cambridge, MA (US); Edin Dhanani, New Delhi (IN)**

(73) Assignees: **The Charles Stark Draper Laboratory, Inc., Cambridge, MA (US); The Trustees of the University of Pennsylvania Penn Center for Innovation, Philadelphia, PA (US)**

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 156(b) by 0 days.

(21) Appl. No.: **16/802,642**

(22) Filed: **Jun. 7, 2018**

(65) **Prior Publication Data**
 US 2018034011 A1 Nov. 22, 2018
 Related U.S. Application Data

(66) Continuation of application No. 15/095,541, filed on Sep. 5, 2017, now Pat. No. 10,261,794, which is a (Continued)

(51) Int. Cl. **G06F 9/50 (2018.01); G06F 9/54 (2018.01)**
 (Continued)

(52) U.S. Cl. **G06F 9/5008 (2018.01); G06F 9/5007 (2018.01); G06F 9/5006 (2018.01)**
 (Continued)

(58) Field of Classification Search **G06F 12/0875; G06F 12/1408; G06F 12/1458; G06F 15/78; G06F 21/52**
 (Continued)

References Cited
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 5,201,610 A 4/1991 Dural
 5,277,136 A * 12/1994 Takemura G06F 9/503
 (Continued)

FOREIGN PATENT DOCUMENTS
 GB 2519668 A 4/2015
 WO 201628310 A1 3/2016
 (Continued)

OTHER PUBLICATIONS
 Nikolai Zeldovich et al., Hardware Enforcement of Application Security Policies Using Tagged Memory, Proceedings of the 16th USENIX conference on Operating system design and implementation pp. 225-240 (2008).
 (Continued)

Primary Examiner – **Sharon S Lynch**
 (74) Attorney, Agent or Firm – **Hamilton, Brook, Smith & Reynolds, PC**

ABSTRACT
 A method includes receiving, for metadata processing, a current instruction with an associated metadata tag. The metadata processing is performed in a metadata processing domain isolated from a code execution domain including the current instruction. Each respective associated metadata tag representing a respective policy of the composite policy. The associated metadata tag further including pointers to tags of a component policy of the composite policy. For each respective metadata tag, the method includes determining, in the metadata processing domain and in accordance with the metadata tag and the current instruction, whether a rule exists in a rule cache for the current instruction. The rule cache including rules to be applied to metadata processing to define allowed instructions. The determination of whether a rule exists resulting in a respective output. The method further includes generating a composite result tag by combining the respective output into a single metadata tag (Continued)

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What is claimed is:

1. A method of processing instructions comprising: receiving, for metadata processing, a plurality of metadata tags associated with a current instruction, said metadata processing being performed in a metadata processing domain isolated from a code execution domain including the current instruction, each of the plurality of metadata tags relating to a respective component policy of a composite policy; processing the plurality of metadata tags in parallel by respective rule cache miss handlers comprising a plurality of hardware rule handlers, wherein processing, for each metadata tag of the plurality of metadata tags, comprises: determining, by a respective rule cache miss handler, in the metadata processing domain and in accordance with the metadata tag and the current instruction, whether a rule exists in a rule cache for the current instruction, said rule cache including rules on metadata used by said metadata processing to define allowed instructions; and providing a respective output; generating a composite result tag by combining the respective outputs into a single metadata tag for the composite policy including each respective policy; and simultaneously enforcing, by the plurality of hardware rule cache miss handlers, each of the policies for the current instruction, each of the policies enforced by a respective hardware rule cache miss handler.

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XILINX FPGA US 4,870,302

(57) **ABSTRACT**

A configurable logic array comprises a plurality of configurable logic elements variably interconnected in response to control signals to perform a selected logic function. Each configurable logic element in the array is in itself capable of performing any one of a plurality of logic functions depending upon the control information placed in the configurable logic element. Each configurable logic element can have its function varied even after it is installed in a system by changing the control information placed in that element. Structure is provided for storing control information and providing access to the stored control information to allow each configurable logic element to be properly configured prior to the initiation of operation of the system of which the array is a part. Novel interconnection structures are provided to facilitate the configuring of each logic element.

I claim:

1. An interconnect structure for programmably interconnecting lines within an integrated circuit comprising:

at least three sets of interconnect line including a first set, a second set, and a third set; programmable means, not including said sets of interconnect lines, for connecting at least one of said lines in said first set to at least one of said lines in said second set, for connecting at least one of said lines in said first set to at least one of said lines in said third set, and for connecting at least one of said lines in said second set to at least one of said lines in said third set.

2. An array of interconnect structures, each said interconnect structure as in claim 1, and each interconnect structure in said array having its own selected number of interconnect lines and its own programmable means for connecting interconnect lines in its own first, second and third sets.

<https://patents.google.com/patent/US4870302A/en?q=us+4870302>

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ENIAC US 3,120,606

- × 1. MEANS FOR PRODUCING **ELECTRIC PULSES** IN SEQUENCE, ELECTRONIC MEANS FOR ALTERNATELY TRANSMITTING CERTAIN ONES OF SAID PULSES AS RECURRENT DIFFERENTIATED GROUPS, ELECTRONIC MEANS FOR SELECTING PARTICULAR PULSES FROM ONE OF SAID DIFFERENTIATED GROUPS TO REPRESENT QUANTITATIVE VALUES, ELECTRONIC MEANS FOR SELECTING PARTICULAR PULSES FROM ANOTHER OF SAID DIFFERENTIATED GROUPS TO REPRESENT CERTAIN QUALITATIVE VALUES, READING MEANS RESPONSIVE TO PULSES REPRESENTING BOTH THE QUALITATIVE AND QUANTITATIVE VALUES FOR **READING DATA TO BE PROCESSED UPON COMMAND** OF AT LEAST ONE OF SAID QUALITATIVE PULSES, STORING THE DATA THUS READ, AND MAKING THE DATA AVAILABLE IN THE FORM OF DATA PULSES IN RESPONSE TO AT LEAST ONE OTHER OF SAID QUALITATIVE PULSES, AND ELECTRONIC MEANS FOR RECEIVING SAID DATA PULSES AND RESPONSIVE THERETO FOR **PERFORMING ELECTRICAL SWITCHING OPERATIONS OF A NATURE DETERMINED BY SELECTED ONES** OF SAID QUALITATIVE VALUES AND OF A DEGREE DETERMINED BY SELECTED ONES OF SAID QUANTITATIVE VALUES.

<https://www.computerhistory.org/revolution/birth-of-the-computer/4/99/387>

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WHAT'S PATENTABLE

- × **Not law's of nature**
- × **Not abstract ideas**
- × **Cannot patent pi (π)**
- × **Software?**
 - + Originally not
 - + With reference to machine, can often manage
- × **Genetic sequences?...**
- × **...evolving...**

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COPYRIGHT

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COPYRIGHT

- × **Cover particular, original expression**
 - + Including software
- × **Technically don't need to register**
 - + But should...
 - + Must register before sue for infringement
 - + \$45
 - × <https://www.copyright.gov/about/fees.html>
 - + No review, just registration
- × **Life of author + 70 years**
- × **Work for hire: 95 years from publication**

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LICENSING

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LICENSES

- × **How get right to use**
 - + Something patented, copyrighted by someone else
- × **Between companies**
 - + Get IP need to build a product
- × **To consumers**
 - + Technically, most software is licensed, not sold
 - + ...shrink-wrap/click-through licensing agreements...
- × **Define terms of use**
 - + What you are paying for (one copy, many, resale...)
 - + What uses (dis)allowed

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OPEN SOURCE / CREATIVE COMMONS

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SHARING

- × **Sometimes we want to share**
 - + Isn't it great doesn't cost us anything to give away digital products?
 - + Isn't it great can build on work of others without necessary cost?
 - + Cooperation on standards create opportunities for everyone, for an industry

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CHALLENGE

- × **Patents cost money**
- × **Business (people making money) will spend money to patent things**
 - + ...and typically incentivized to patent everything they can
- × **Company (individual) could patent something and grant free license**
- × **How does individual, non-profit, etc.**
 - + Create something and protect right to share?
- × **Variety of Open-Source/Public Domain licenses**


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CREATIVE COMMONS

- × **Framework and set of licenses for clearly expressing intent**
- × **Issues**
 - + Attribution
 - + Share-Alike
 - + (Non-)commercial
 - + (No)Derivatives
- × **Apps to choose, logos to show, legal backing to define precisely**
- × **<https://creativecommons.org/share-your-work/licensing-types-examples/>**



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NON-DISCLOSURE AGREEMENT (NDA)

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NDA

- × **Tool for protecting IP**
- × **Legal agreement that you won't disclose information shared with you**
 - + Prevent loss of IP
- × **Typical for collaborating companies**
- × **Typical for employers**
- × **In part to make sure sharing with you doesn't count as "disclosure" to preclude patents**
- × **Define scope of disclosure**

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WHO OWNS IP?

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US010261794B2

(12) **United States Patent** (10) **Patent No.: US 10,261,794 B2**
DeHon (45) **Date of Patent: Apr. 16, 2019**

(54) **TECHNIQUES FOR METADATA PROCESSING** (56) **References Cited**
 U.S. PATENT DOCUMENTS
 (71) Applicant: **The Charles Stark Draper Laboratory, Inc., Cambridge, MA (US)** 5,201,056 A 4/1993 Daisel et al.
 6,298,032 B1 10/2001 Goto (Continued)
 (72) Inventor: **Andre' DeHon, Philadelphia, PA (US)**
 (73) Assignee: **The Charles Stark Draper Laboratory, Inc., Cambridge, MA (US)** GB 3519668 A 4/2015
 WO 201008316 A1 3/2010 (Continued)
 (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.
 FOREIGN PATENT DOCUMENTS
 (21) Appl. No.: **15/695,541** Ujii, Dhawan, et al., "PUMP: A Programmable Unit for Metadata Processing. In Proceedings of the 3rd International Workshop on Hardware and Architectural Support for Security and Privacy", Jun. 2014.
 (22) Filed: **Sep. 5, 2017**
 OTHER PUBLICATIONS
 (65) **Prior Publication Data**
 US 2018/0011708 A1 Jan. 11, 2018 (Continued)
Related U.S. Application Data
 (60) Division of application No. 15/426,698, filed on Feb. 7, 2017, now Pat. No. 8,783,440, which is a (Continued)
Primary Examiner—Sharon S Lynch
 (74) **Attorney, Agent, or Firm**—Hamilton, Brook, Smith & Reynolds, P.C.
 (57) **ABSTRACT**
 Techniques are described for metadata processing that can be used to encode an arbitrary number of security policies for code running on a processor. Metadata may be added to

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US005742180A

United States Patent [19] (11) **Patent Number: 5,742,180**
DeHon et al. (45) **Date of Patent: Apr. 21, 1998**

(54) **DYNAMICALLY PROGRAMMABLE GATE ARRAY WITH MULTIPLE CONTEXTS** Demnan, M.M., "The Yorktown Simulation Engine," *IEEE 19th Design Automation Conference*, pp. 55-59 (1982).
 Razdan, R., et al., "A High Performance Microarchitecture with Hardware-Programmable Functional Units," *Micro-27 Proceedings of the 27th Annual International Symposium on Microarchitecture*, San Jose, California, pp. 172-180 (Nov. 30-Dec. 2, 1994).
 (List continued on next page.)
Primary Examiner—Edward P. Westin
Assistant Examiner—Jon Santamauro
Attorney, Agent, or Firm—Hamilton, Brook, Smith & Reynolds, P.C.
 (57) **ABSTRACT**
 An integrated dynamically programmable gate array comprises a two dimensional array of programmable gates. These gates can be implemented as look up tables but hardwired gates with programmable interconnections are also possible. Each one of the gates receives plural input logic signals from plural other gates. Consequently, a broad range of logic combinations are possible. The gates further include locally stored multiple contexts dictating different combinatorial logic operations performed by the gates. The contexts increase the logic operations performable by the gate and the fact that the contexts are locally stored enables:

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WORK SCENARIOS

- ✘ **Hired/paid by company to invent**
 - + Belongs to company
- ✘ **Invent on side on free time**
 - + ...may depend on employment agreement
 - + ...whether or not subject matter overlaps with company
- ✘ **Consultant**
 - + By default yours, but consulting agreement may define

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UNIVERSITY

- ✘ **Based on grant funds and resources**
 - + Typically goes to university and funding source
 - + Right of first refusal...won't always pursue
- ✘ **Undergraduate**
 - + Invent in class, senior-design → yours
- ✘ **Graduate students paid RA from grant**
 - + Typically funded by grant and go to University
- ✘ **Undergraduate paid research (employee)**
 - + Typically funded by grant and go to University
- ✘ **Graduate students in class, using class resources**
 - + Goes to University

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LEARN MORE

- ✘ **EAS 5070 – IP and Business Law for Engineers**
- ✘ **EAS 5450 – Engineering Entrepreneurship**
 - + Has sections on IP

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BIG IDEAS

- × **We (engineers...particularly in computing space) are knowledge workers, producing IP**
- × **IP carries great value**
 - + That is less and less tied to physical objects
- × **Need to equitably reward and encourage IP creation**
- × **Patents, Copyrights...two of the things that**
 - + Attempts to provide framework for IP ownership, sharing, monetization
 - + ...probably not the final answer, particularly as technology landscape continues to evolve.

REMEMBER

- × **Feedback**
- × **Lab 11 due today**
- × **Lab 12 today**
 - + Bring lab kits