arm Research Summit

Resources for Teaching and Learning

Arm Education

Robert Iannello

9th September 2020

Arm Education: Vision and Mission

Vision

- To play a leading role in plugging the education, and skills gap in computing for the benefit of scholarship and society

Mission

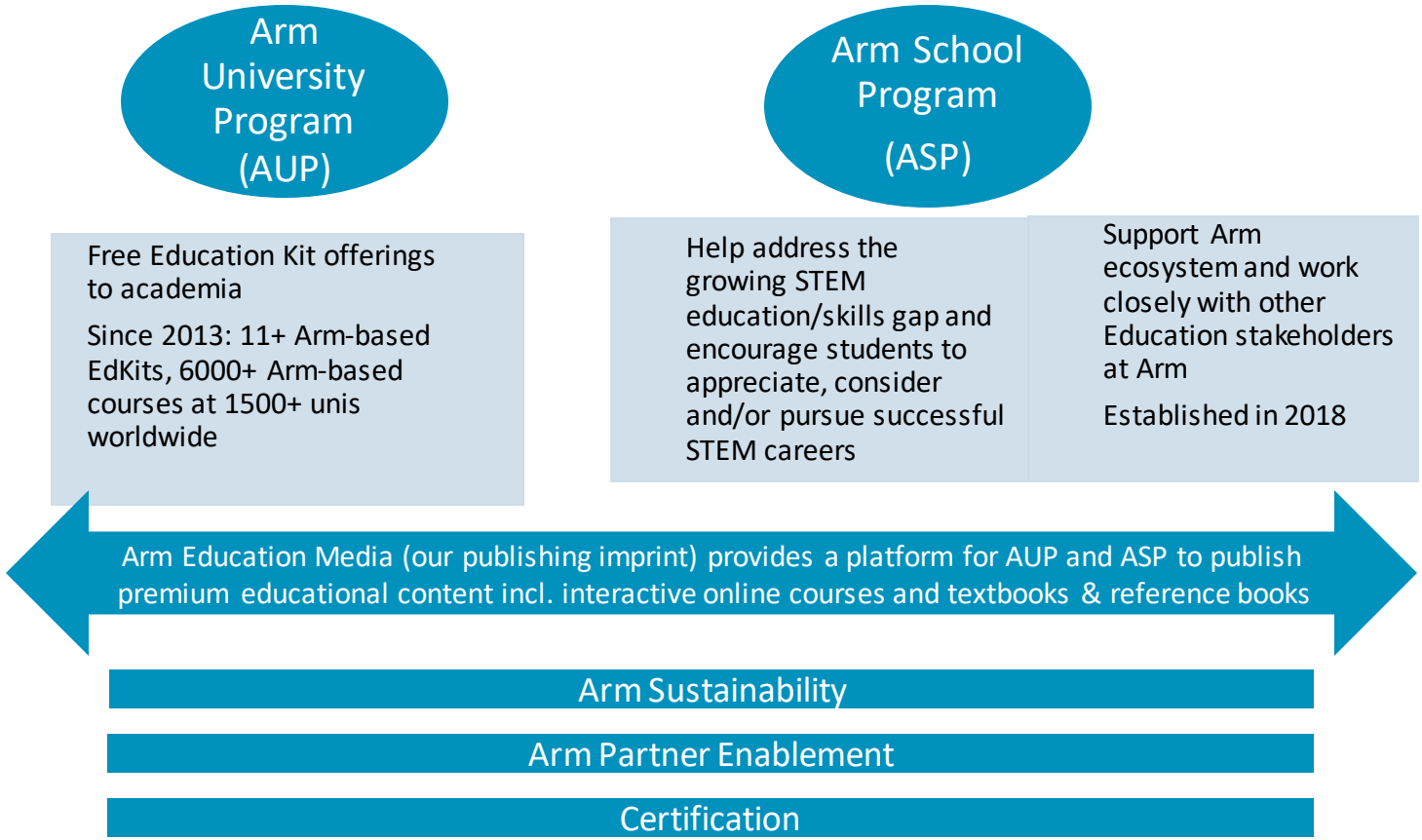
- To help academics access state-of-the-art technologies, tools and know-how from the Arm ecosystem so that they can educate, train and innovate effectively in the modern economy.

Goals

- Creating an environment where industry can contribute to the education of the next generation of engineers through the creation of up-to-date teaching materials.
- Creating affordable and easy to understand content that removes entry barriers to teaching and learning.
- Attracting new participants and increasing diversity in engineering, via accessible teaching materials.

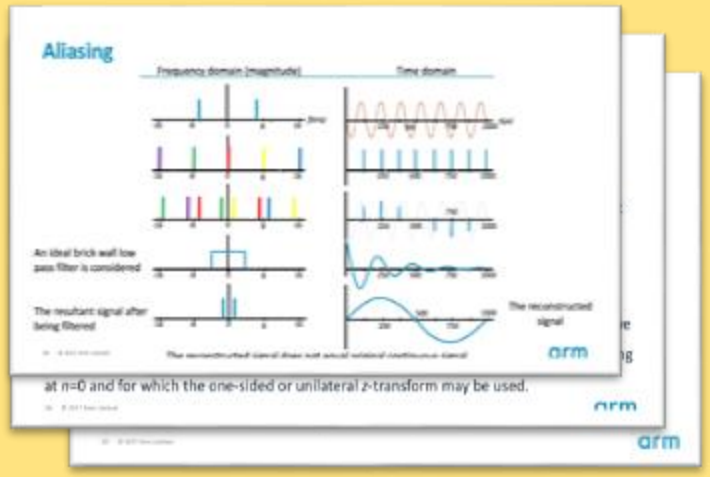
Arm Education: State of Play

Addressing the Education/Skills Gap



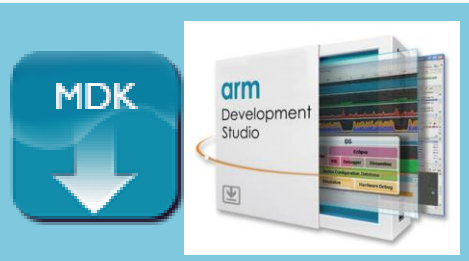
Arm University Program

Arm University Program Education Kit

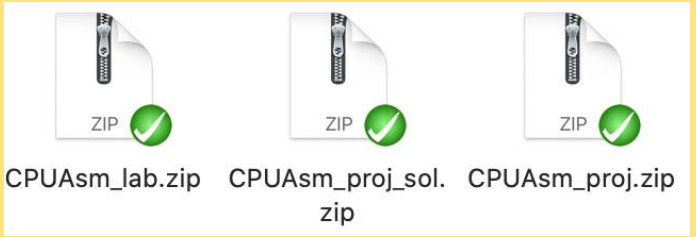


Slides, quizzes, exam questions

Lab manuals



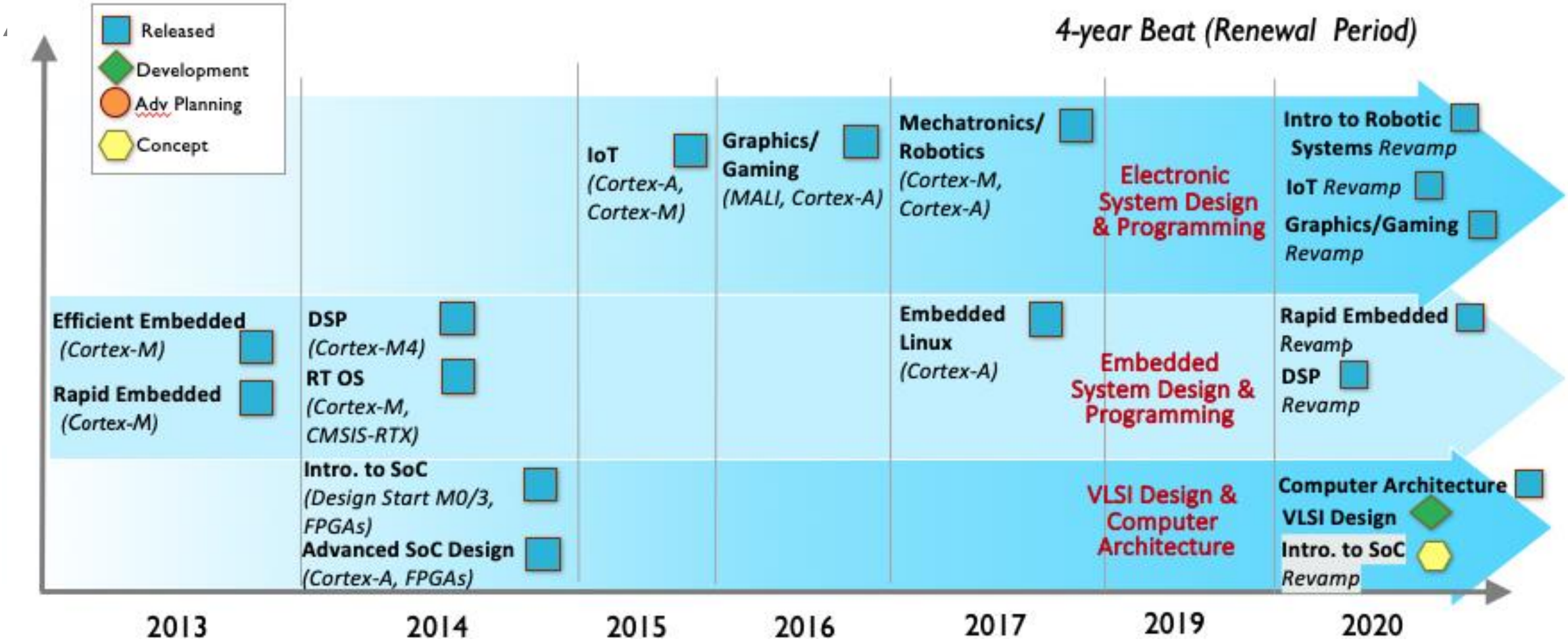
Software tools (Arm Development Studio, Keil, etc.)



Code solutions

Education Kits Roadmap

arm University Program



arm Research Summit

Example: Introduction to Computer Architecture Education Kit

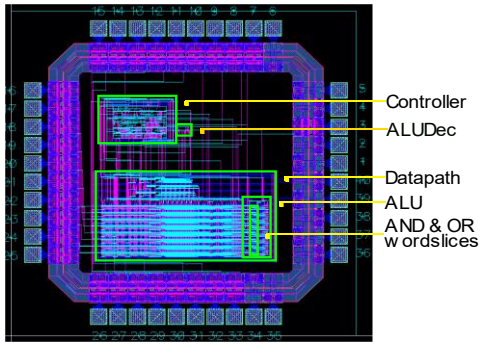
- *Aim*
  - Teach the fundamental concepts of computer architecture and how these concepts are applied and implemented in modern processors
- *Labs*
  - A 5-stage simple processor running a subset of Armv8-A instructions (AArch64)
  - Students can modify this processor to implement Comp. Arch. concepts, such as pipelining, forwarding paths, stalls, etc.
  - Students gain full hands-on experience to students into the RTL, rather than just observing black box behavior with processor models.
  - Tools: Icarus Verilog, GTKWave, GNU GCC , etc.

Lecture	Lab
1. Introduction to computer architecture	Getting Started
2. Fundamentals of computer design	Lab 1 – Running Assembly on "Educore"
3. Pipelining	Lab 2 – Armv8-A Assembly encoding
4. Branches and limits to pipelining	Lab 3 – "Educore" microarchitecture
5. Exploiting instruction-level parallelism	Lab 4 – Simple pipeline
6. Memory	Lab 5 – Forwarding paths
7. Caches	Lab 6 – Stalls, Control Hazards, and PPA estimation
8. Multicore	
9. Multithreading	
10. Vector SIMD, GPU	
11. SoC study	

Example: VLSI Fundamentals Education Kit

- *Aim*
  - Teach the fundamentals of VLSI design and application of these concepts in simulation, verification and physical implementation of a simplified microprocessor using standard industry tools.
- *Labs*
  - Implement a simple microprocessor with industry standard EDA tools
  - Practice ASIC design workflow: simulation, synthesis, verification, place and route, etc.

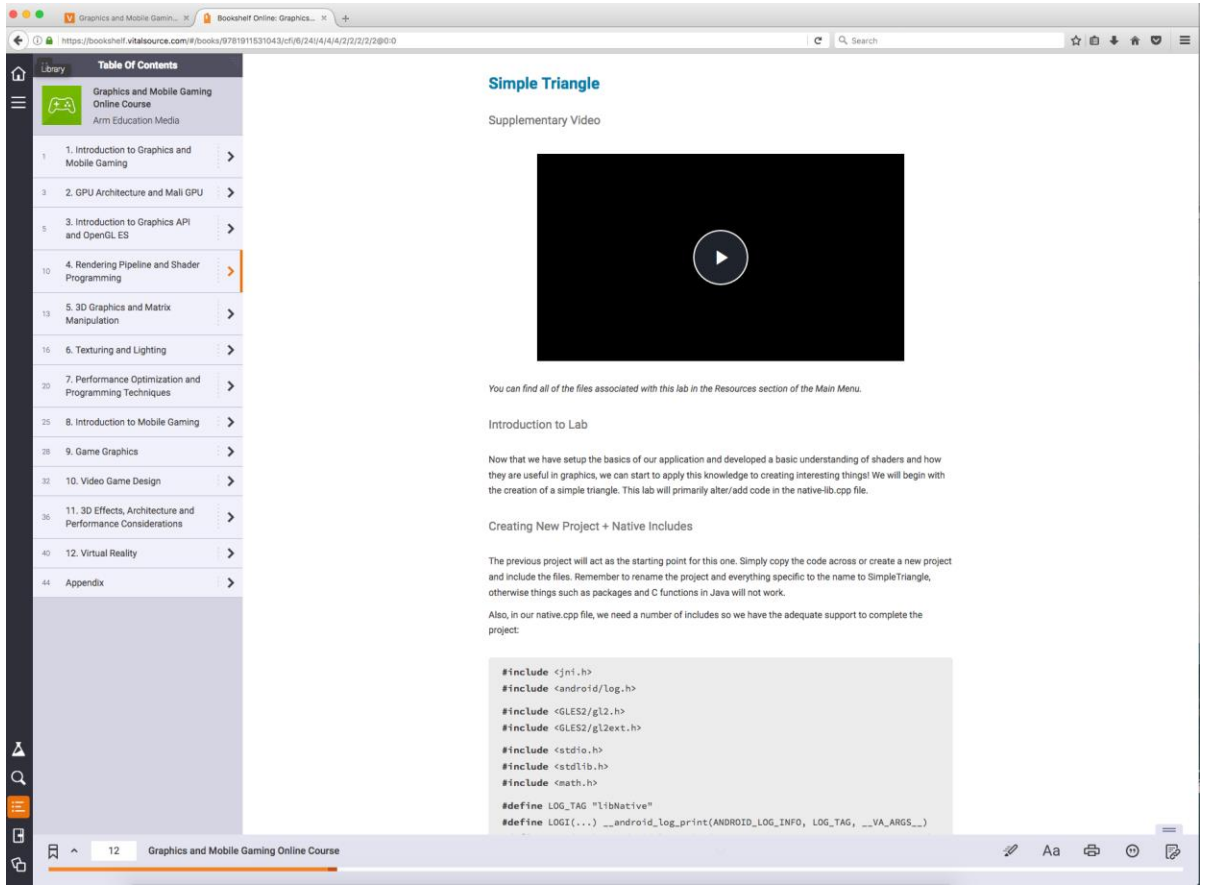
Complete processor Chip Layout



Week	Lecture 1	Lecture2	Lab
1	1: Introduction to VLSI	2: Circuits and Layout	Getting Started
2	3: VLSI Flow	4: Ideal Transistors	
3	5: Nonideal Transistors	6: DC & Transient Response	1: Leaf Cell Design
4	7: Logical Effort	8: Power	
5	9: Scaling	10: Simulation	2: Datapath Design
6	11: Combinational Circuits	12: Sequential Circuits	
7	13: Wires	14: Adders	3: Synthesis, P&R
8	15: Datapath Component	16: Memories	
9	17: Clocking	18: Variation & Reliability	4: Chip Assembly
10	19: Design for Test	20: Full Custom Design	

Cornell Testimonial Video – Arm University Program Education Kit

Online Courses



Lecture Videos

split thematically

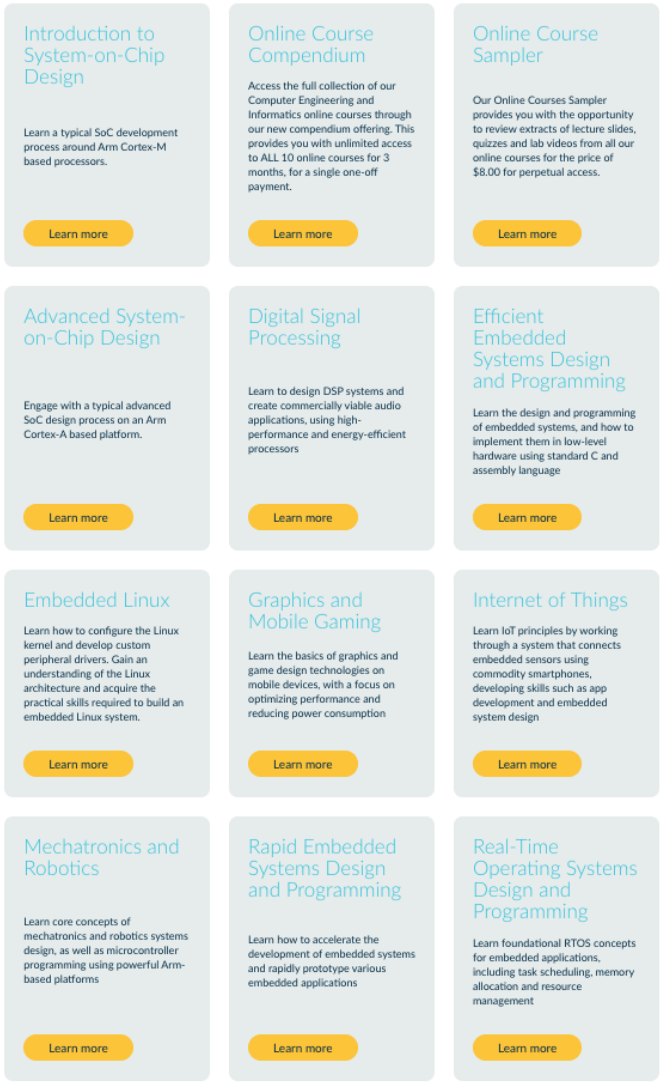
Lab Videos

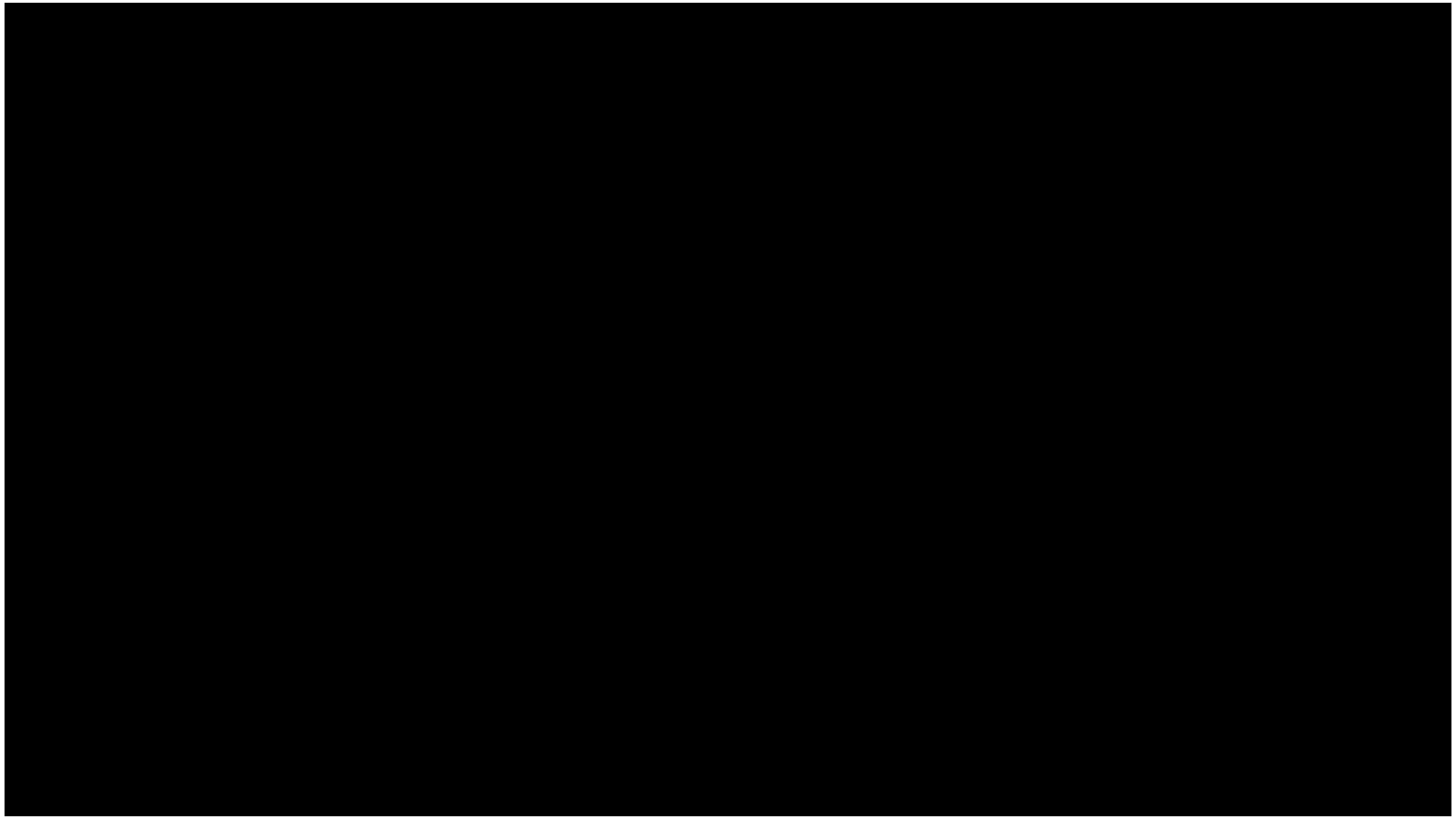
split thematically

Interactive Quizzes

multiple choice questions and problems with answers

Online Courses





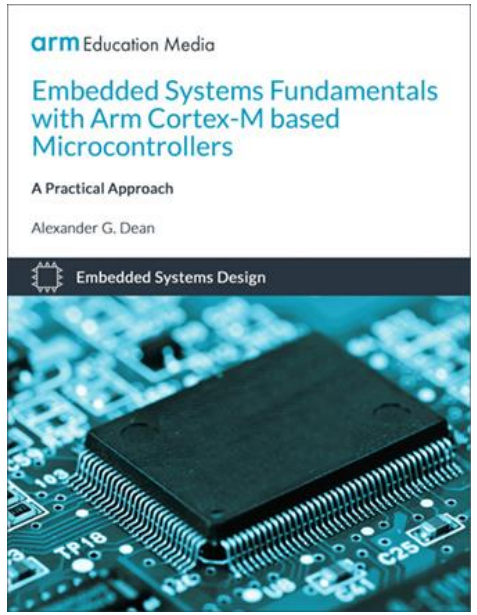
edumedia@arm.com

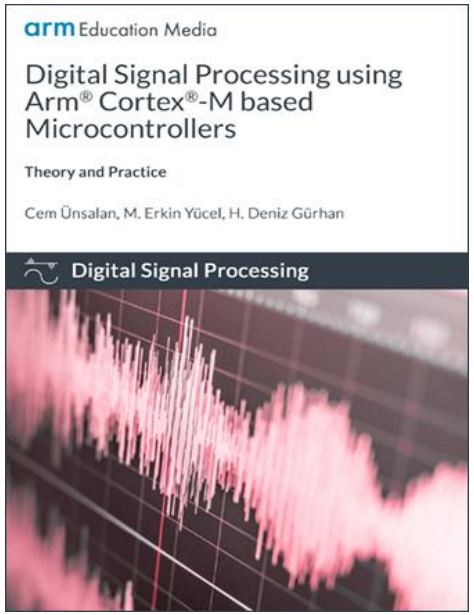
Heriot-Watt University Testimonial – Online Courses

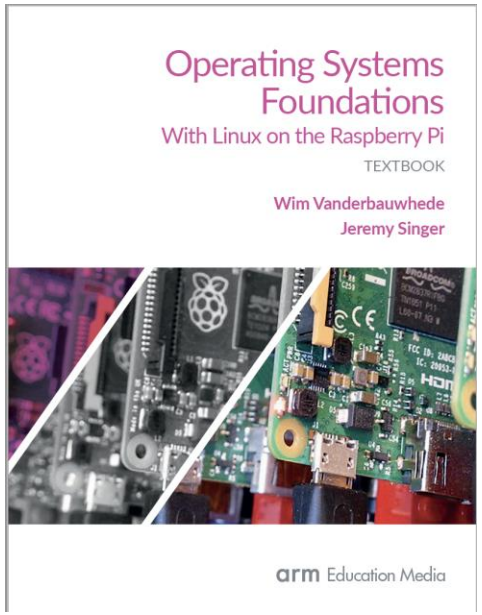
E-First Textbooks and Reference Titles

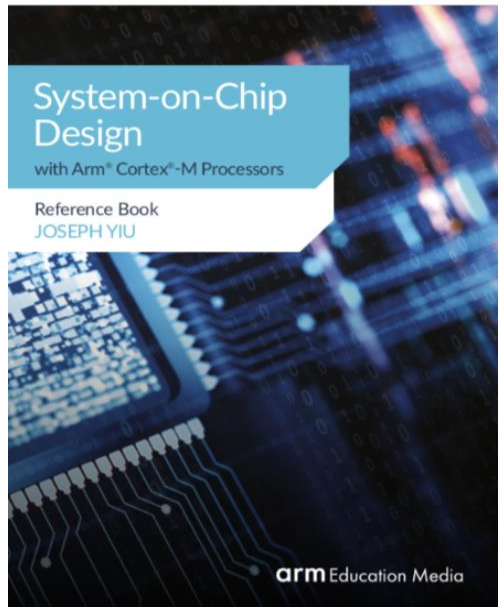
Complements online courses with wider coverage of topics

Digital-First with Print-on-Demand

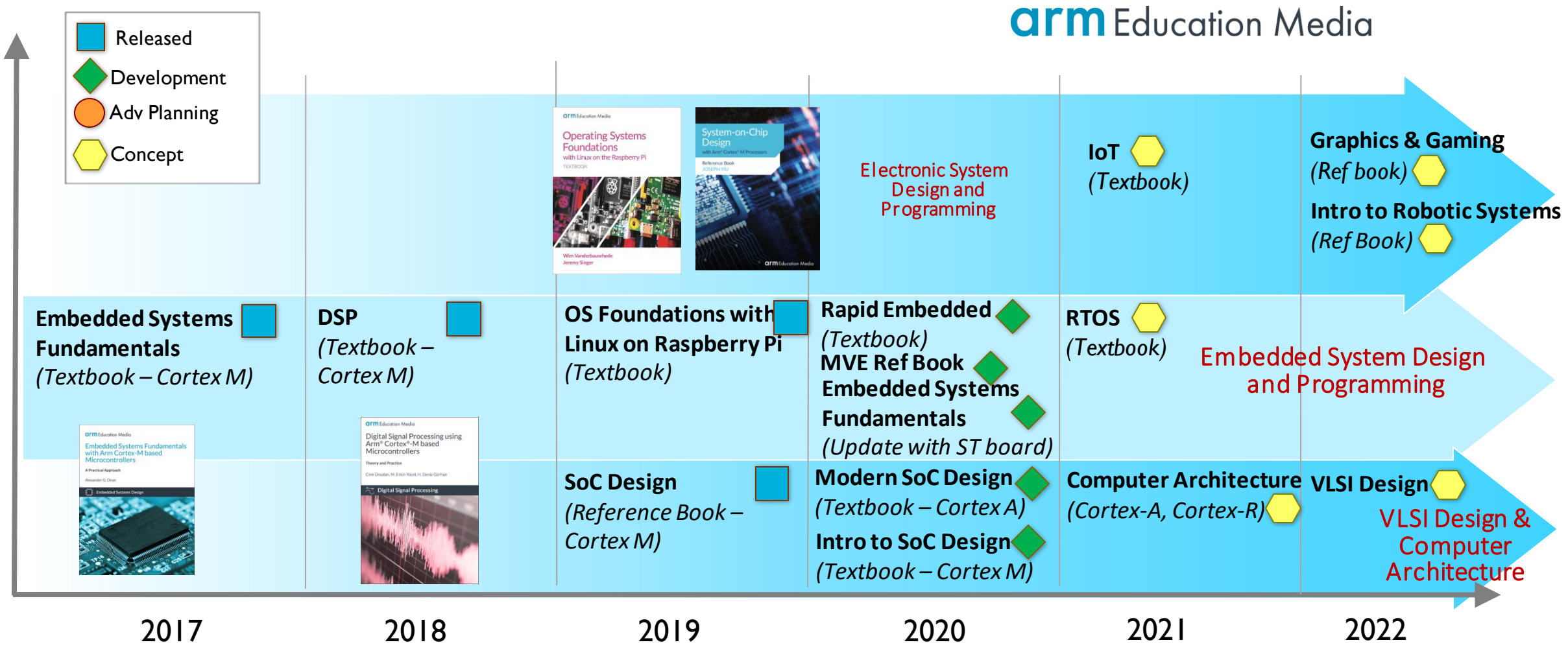








Textbooks and Reference Works



Arm Education Hub

Solving Community Challenges In India: IIT Bombay Spearheads Healthcare Initiatives

Suriya Gunasekaran 14 May 2020

Introduction

Medical devices are essential for healthcare. Indigenous development of novel, suitable, reliable, and affordable devices lead to social impact and high-value jobs in the country where they are created, thereby bolstering the local healthcare ecosystem. From studying the links between genetic code and diseases to promoting higher efficiency in hospital management systems, technology is adding a crucial new dimension to the development of biomedical engineering and research.

From a contextual standpoint, increasing community challenges offer the opportunity for a wider and more diverse set of contributors to get involved, especially in the Indian market. Many engineering and technology students now have the skills, knowledge, and tools to develop advanced instruments and solutions that can have a substantial, positive impact on the provision of medical triage and treatment.

To guide us through the key initiatives and innovations in the market, we spoke to Professor B. Ravi, Institute Chair Professor for Mechanical Engineering at IIT Bombay, who also heads BETiC (Biomedical Engineering & Technology Incubation Center). In this blog, he discusses how BETiC and its partners have developed some key medical devices and takes a wider look at how applied research has solved community challenges.

Why is IIT Bombay the ideal place for building innovative technology solutions in India?

IIT Bombay is recognized worldwide as a leader in the field of engineering education, research, innovation, and entrepreneurship. I envisioned the Biomedical Engineering and Technology (incubation) Center (BETiC) at IIT Bombay to help provide a platform for entrepreneurship and innovation, which could support various medical design projects.

However, BETiC was not solely created for IIT Bombay. It has expanded to other renowned educational institutions that have a similar strategic vision, such as COE Pune and elsewhere.

Can you describe your research and innovation labs for us?

BETiC was established in 2014 to catalyze indigenous medical device innovation and entrepreneurship. It facilitates rapid translation of innovative ideas from surgeons into high-quality and affordable medical devices, suitable for the local population. Its work is supported by key national and local government

Success with Online Learning: A Curated Collection of Resources for Academics

Robert Iannello 16 Apr 2020

The COVID-19 virus is having a profound impact across all aspects of society, including the provision of education. **According to a recent article in** Inside Higher Education, "teaching online requires an intentional, thoughtful approach to instructional design, especially when students are being asked to transition pace in the wake of COVID-19." **During** this period of uncertainty, the Arm Education team would like to assist university academics in their efforts to manage this rapid transition to online learning. In this post, we gather a collection of practically focused global resources that will hopefully provide teaching staff with a useful head-start.

Managing the Transition to Online Learning

Academics are familiar with Jisc, the not-for-profit organization that provides technology solutions for the U.K's education and research sector. They have recently posted 'common sense steps' on how U.K. academics can continue to provide "support and a meaningful level of teaching and learning" to students during this unprecedented move to online education. Tips include how to deliver lectures online, provide virtual assessments, manage student inductions and recommendations on how to ensure that student well-being is maintained during this difficult period.

Additional recommended reading on this subject:

- The journal Nature has recently published five tips for moving teaching online.
- The Times Higher Education has a case study on how the Singapore Institute of Technology managed a swift transition to online learning as a result of the COVID-19 outbreak.
- The Australian Tertiary Education Quality and Standards Agency has produced an Online Learning Good Practice.
- **If you are looking for hands-on advice on virtual teaching, the American Association of University Professors have resources on distance teaching – including a Online Teaching Transition toolkit and Humanizing Online Teaching.**
- The Chronicle of Higher Education has published an excellent list of emergency guidelines for teaching online which have been produced by a number of U.S universities.

Free Academic Content for Teaching and Research

Many publishers are making their pay-walled content freely available for an extended period. This includes access to journal content, textbooks, and monographs.

Jisc has provided a comprehensive summary of publishers which have extended access to their content for academic institutions here. **Additionally, Chest, a body responsible for negotiating software licenses for educational institutions has provided an overview of the home use rights they have secured with providers such as Adobe and Microsoft.**

For other global perspectives, check out this excellent list posted by the International Coalition of Library Consortia (ICOLC), who are providing complimentary access to their content at an institutional level. If you require specific details for your region, we recommend you browse the ICOLC website to review the resources that the academic library consortium in your country is making available to faculty and students.

The Arm Education team are also offering a range of resources to universities to assist in the teaching of core Computer Engineering and Electronic Engineering courses on Arm. We can partner with academic instructors over the next months to open-up free access to our online courses and digital textbooks for a six-month period. To discuss this further, please email university@arm.com.

Outcomes And Impacts, Not Just Activity And Outputs

Khaled Benkrid 4 May 2020

In a previous blog, I wrote about the reproducibility crisis in research, how it is impacting the quality of research and public trust in it, and how the community of knowledge can address this crisis. In this blog, I will focus on measures of performance and how confusion on what really matters, and agency problems can lead to considerable inefficiencies and distortions. At the heart of many of these problems is conflation of outputs, outcomes and impacts. The value pipeline figure below aims to clarify this.

Figure 1. Value Pipeline

Naturally, any project requires a set of "inputs" or resources necessary for the work needed. This can include funding, raw materials, but also human resources and other forms of capital. The cost of input acquisition, at the desired quality, is an important economic factor.

Inputs are subsequently converted through activity into "outputs" which are the direct measurable deliverables of the project. In the context of research projects, for example, these could be publications or number of trained researchers produced. The rate of converting inputs into outputs dictates the efficiency of the project.

From outputs then come "outcomes" which depict the short- and medium-term value obtained from the project. In the context of research projects, this could be a successful knowledge and technology transfer. Longer term value is referred to as "impact", which in the context of research projects, could be the wider socio-economic value e.g. the creation of a self-sustained ecosystem of talent or the wide deployment of a life enhancing technology. The rate of converting outputs into outcomes and impacts dictates the efficacy of the project.

In the remainder of this blog, I will attempt to demonstrate how conflating the above pipeline stages can lead to confusion, inefficiencies and distortions. As in my previous blog, I will do this through examples from three different fields: engineering, medical sciences, and social sciences.

X CoreMark/MHz, So What?

Benchmarking is routinely used to compare the relative performance of different processors. CoreMark [1] is a widely used benchmark to measure the performance of processors in embedded systems. SPEC CPU benchmarks [2] such as SPECint and SPECfp are used to measure the performance of CPUs used in higher performance systems e.g. servers. However, nothing prevents anyone from using and publishing the results of any benchmark on any system. So, it is possible to run the CoreMark benchmark on a high-performance multi-core processor and show a very high score compared to lower performance embedded systems. That could then be used to market that processor to non-discerning users. However, the CoreMark benchmark is just an output, the value is derived from outcomes and impacts, which look at customer or user value within an application area e.g. low-power embedded systems. The value would typically derive from a Performance Power Area (PPA) or Performance Power Cost (PPC) sweet spot in an application area, but also from ease of use, programmability, maintainability and security. Seen through this lens, a high CoreMark score on its own and without context is meaningless.

It is also worth noting that some of the confusion emanates from what really constitutes an embedded system in the first place. Most people would say: an embedded system is a computer system dedicated to a particular function. That is generally the case for highly constrained environments where there is a need for a computer to perform specific tasks under constraints e.g. power, area, time, cost. By this definition, mobile phones could qualify as embedded systems - they certainly did in their early days when mobile phones were used mostly for making calls or sending text messages. However, as mobile phones

Tips For Home-Schooling

Khaled Benkrid 26 Jun 2020

The COVID-19 pandemic is having a profound impact on the education of our children. Many of them have been unable to attend regular school for months, and many parents have suddenly found themselves in the position of their teachers, or at least their teaching assistants. How should parents, who have no formal teacher training, deal with this situation? This blog gives some high-level tips for parents on home schooling, including a few Do's and Don'ts, which I hope will be useful to many of our readers. Whether you can allocate one hour, two hours or six hours per day to your child's home schooling, these tips should still be applicable.

Prepare the study environment

It is important for your child to have a set space for learning at home, and a set timetable too. Familiar surroundings and routine study times help concentrate minds. It would be helpful, although not necessary, if you could replicate some of the school environment i.e. a set desk with all study materials and tools, In a well-lit and well-ventilated area of the house. Study times like school timetables should also give a sense of familiarity and continuity.

You should consult with your child when designing the study environment, timetabling and agenda. Making them part of this process will help secure their buy-in and engagement.

What you should do during study times

Parents are advised to sit close-by, not necessarily in the same room, while children are studying. They should make themselves available to help, if need be, while minimizing the frequency of interruptions and amount of help to the strict minimum necessary. It is hard to see your children struggle with homework but giving too much help is counterproductive to the learning process, so resist the urge to intervene at the slightest sign of struggle. Put it this way: struggling can be key to unlocking the necessary neural activities and connections in the brain, which are necessary for deep learning to take place. That does not mean you should take a completely detached approach, far from it. You should stand by, monitor, and check on their progress regularly. But how do you provide help when needed? The next tip gives the answer.

Scaffolding

The concept of Zone of Proximal Development (ZPD) has been defined by Soviet-era Psychologist Lev Vygotsky as [1]:

"*the distance between the* ***actual developmental level*** *as determined by* ***independent problem solving*** *and the level of* ***potential development*** *as determined through problem-solving* ***under adult guidance***, *or* ***in collaboration with more capable peers***"

In other words, ZPD is the distance between what your child can do without help, and what they can do with support from someone with the necessary knowledge and expertise.

So, when your child is in the ZPD of a task, your job is to give them enough of a boost or scaffold to perform the task in hand. With gradual boost, your child will eventually build the necessary knowledge, skill, and confidence to be able to perform the task without any support. Your job is to help them get there one step at a time by giving just the right amount of scaffold (no more and no less). Each time they repeat the task, you remove some of that scaffolding, until they can perform the task independently.

Repetition is crucial in this context e.g. the skill to solve a quadratic equation might require dozens of different examples and tests. It is perfectly normal for you to give your child some scaffolding in the first few examples, after imparting them with the necessary knowledge e.g. by asking questions such as "are you sure about this?", "Take me through your thinking process here", while pointing to the problematic areas in their reasoning. Note that sometimes all what your child needs is a better explanation of the question or problem in hand. Overt time, your child will gradually be able to solve the following examples of the task increasingly independently, until full independence.

https://community.arm.com/education-hub

Why Arm? A Day in the Life of a Student

arm

Thank You
Danke
Merci
谢谢
ありがとう
Gracias
Kiitos
감사합니다
धन्यवाद
شكرًا
תודה