The ARM University Program

The ARM University Program connects educational and research institutions to a variety of ARM materials, including development tools and platforms, IP, and starting points.

Students and faculty members involved in university courses or projects concentrating on system-on-chip (SoC) design, computer architecture, embedded systems development, or assembly programming can benefit from ARM technology.

Who is ARM?

ARM Holdings is the industry’s leading provider of microprocessor IP. Unlike many semiconductor companies, ARM does not manufacture microprocessors or microcontrollers. Rather it licenses its processor IP to the majority of the leading semiconductor silicon manufacturers. Over 26 billion ARM processors have been shipped since the company was formed in 1990.

ARM offers a wide range of processor IP based on a common architecture that delivers high performance together with low-power consumption and system cost. This energy-efficient performance is enhanced by ARM Artisan® advanced Physical IP, Keil® development tools, and the broad ARM ecosystem of third-party systems, design support, software, and training providers which collectively deliver a complete solution for products based on the ARM architecture.

Why should you choose ARM?

Technology is outpacing the changes made in many older curricula. Processors that once dominated the academic space are losing their relevance in today’s world as more efficient and more powerful designs take their place. By partnering with ARM, educational institutions empower their students with real-world, commercial technologies and tools at the heart of a wide range of industries. More than 250 companies are currently licensed to use ARM processor cores, making experience with ARM a distinguishing asset for graduating students. With this in mind, many leading educators, such as University of Michigan, Purdue University, Durham University, and University of Luebeck have already transitioned to ARM processors, ARM Physical IP, and modern development tools in their academic curriculum and research.

The ARM University Program reduces the initial adoption and migration overhead for universities by filtering the vast amount of academic choices down to the most-effective, lowest-cost options available. This makes it easy to find development board distributors, free or open source software, as well as a variety of online resources and discussion groups through the ARM University Program web pages.
Processor Cores

ARM designs a wide range of advanced processor IP based on a common architecture that delivers high performance together with low power consumption. The DesignStart™ Online IP portal allows universities to access ARM core evaluation IP, processor simulation environments, and physical IP libraries.

Artisan® Physical IP

By consistently delivering physical IP solutions at the highest level, ARM has become the most widely used IP provider in the industry. Through partnerships made with several regional centers worldwide, it is possible for universities to obtain access to some of ARM’s physical IP libraries. This includes front-end views of standard cell libraries, memory compilers, and I/O. These regional centers also offer technical support for designs and an established channel for researchers to get wafer capacities at leading foundries.

Access to the Cortex-M0 DesignStart Processor and some ARM physical IP libraries are free to approved educational institutions to enhance learning in university courses and to advance associated research. For more details of IP products and services, please visit the ARM University Program web pages:


Questions about ARM IP? Email us at: university@arm.com

ARM-based Hardware Development Platforms

ARM processors power hardware development platforms with a wide range of design complexity levels. From simple microcontroller boards to very advanced multi-core solutions, most ARM-based development boards are manufactured by a variety of ARM partners and sold through distributors. Although ARM sells a small number of boards directly at academic rates, the ARM University Program assists educational institutions in finding the most suitable and affordable hardware tools to meet specific course and project requirements.

ARM Cortex-M Processor Development Platforms

Best suited for students and faculty working on low-cost microcontroller applications, the ARM Cortex-M processor development platforms can be used in a broad range of courses and projects, and provide affordable performance with exceptional system response to interrupts. These development platforms are equipped with the industry’s most popular ARM processor family, specializing in low-power consumption, smaller memory space, and reduced pin counts.
also incorporates the Wake Up Interrupt Controller (WIC) that enables the system to be placed into an ultra low-power retention mode for preserving energy and battery life. It is the industry leading 32-bit processor for highly deterministic real-time applications including microcontrollers, automotive body systems, industrial control systems, and wireless networking.

The Cortex-M0 processor is ARM’s lowest power and most energy efficient processor available. The simplicity of just 56 instructions allows students to quickly master the entire Cortex-M0 instruction set if desired, while the C-friendly architecture means this is not a necessity. The option for fully deterministic instruction and Interrupt timing makes it easy to calculate response times, while the ultra-low gate count enables the processor to effectively engage in analog and mixed signal devices that require low-power connectivity.

The Cortex-M3 processor pushes a high-performance, low-cost processor into a range of applications and can be configured to meet exact requirements with a Nested Vectored Interrupt Controller (NVIC), configurable debug, trace options, and optional memory protection unit (MPU). It

The Cortex-M4 processor is the latest embedded processor developed specifically by ARM to address digital signal markets that demand an efficient, easy-to-use blend of control and signal processing capabilities. Built on top of the innovative technology that characterizes the Cortex-M series is a single-cycle multiply-accumulate unit (MAC), an optimized single instruction multiple data unit (SIMD), saturating arithmetic instructions, and an optional single-precision floating-point unit (FPU).

The following are just a few of the many inexpensive, accessible, and ready-to-use Cortex-M development platforms available from ARM, ARM partners and third-party suppliers.

Keil offers development platforms built around the Cortex-M processor series at academic rates. These platforms are created to help beginners learn about microcontroller (MCU) architecture and come ready to run straight out of the box.

STMicroelectronics™ ARM Cortex-M3 STM32 Value Line Discovery

Perfect for students, the STM32 Value Line Discovery board provides one of the lowest cost complete solutions available for universities looking to teach with ARM processors. It includes an STM32F100 Value Line microcontroller in a 64-pin LQFP package, in-circuit ST-Link debugger/programmer, and links to download a full set of compatible development tools.

NXP™ ARM Cortex-M0 and Cortex-M3 LPCXpresso™

The LPCXpresso is a complete, low-cost development platform from NXP that uses either the Cortex-M0 or Cortex-M3 processors, making application development easier. It uses low-pin-count (LPC) microcontrollers and includes a simplified, Eclipse-based integrated development environment (IDE) with an on-board JTAG debugger.

Freescale™ ARM Cortex-M4 Kinetis™

The Freescale Kinetis processor board takes advantage of the Cortex-M4 in the K40 and K30 families of Kinetis microcontrollers. It is created to get designs to market faster and can be purchased individually or in packages with add-on peripheral boards, tools, and runtime software.

As these represent only a subset of the Cortex-M-based platforms available from suppliers, other options are mentioned in the Development Platforms section of the ARM University Program web pages.
The Cortex-A processor-based development platforms support more advanced solutions for students using devices hosting rich Operating Systems (OS). From ultra-low-cost handsets to high-end smart phones, tablets, and digital televisions, the Cortex-A processor series has the power to match the imagination of students, without the prohibitive energy usage or expense. These platforms provide the ideal choice for students and faculties working on and learning about higher-end multimedia applications, multi-core programming, Digital Signal Processing (DSP), or the development of OS applications.

ARM cores used in many of the Cortex-A Development Platforms

**ARM Cortex-A8 Processor**

The Cortex-A8 processor has the ability to scale in speed from 600MHz to greater than 1GHz, meeting mobile device requirements for operating in less than 300 mW while also running applications requiring 2000 Dhrystone MIPS. This high-performance processor has been proven in millions of end devices today from feature phones to netbooks, printers to automotive-infotainment. It is based on the ARMv7A architecture and includes NEON™ technology for multimedia and SIMD processing.

**ARM Cortex-A9 Processor**

The Cortex-A9 processor combines unprecedented levels of performance and power efficiency with flexibility and functionality. The Cortex-A9 processor can be used within a broad range of high-performance applications as a scalable multi-core processor or as a traditional single-core processor. It is designed around an advanced, high efficiency, out-of-order 8-stage pipeline and can support the configuration of 16, 32, or 64KB four-way-associative L1 caches with up to 8MB of L2 cache through the optional L2 cache controller. The following are just a few of the many inexpensive, accessible, and ready-to-use Cortex-A development platforms made available by ARM, ARM partners, and third-party suppliers.

**ARM Cortex-A8 Texas Instruments BeagleBoard**

Whether developing OS applications or building the next generation tablet device for a senior design project, the Texas Instruments BeagleBoard uses the Cortex-A8 processor in a low-cost, fanless, single-board computer with all of the expandability of today’s desktop machines without the bulk, expense, or noise. Based on the TI OMAP™ 3530 processor, the Beagle runs at 1 GHz and 512MB of low-power DDR RAM. Direct connectivity is supported by the on-board four-port hub with 10/100 Ethernet, while maintaining a tiny 3.25” x 3.25” footprint.

**ARM Cortex-A8 Freescale i.MX53 Quick Start**

The Freescale i.MX53 Quick Start is outfitted with the Cortex-A8 processor to simplify product evaluation and decrease time to market. Optimized for multimedia operations, the i.MX53 Quick Start includes a display controller, hardware-accelerated graphics, 1080p video decode and 720p encode, as well as numerous connectivity options for embedded, industrial, and medical projects and applications.

**ARM Cortex-A9 Dual-Core Panda**

The PandaBoard is a low-power, low-cost, single-board computer that features a dual-core 1 GHz Cortex-A9 MPCore™ CPU, a POWERVR® SGX540 GPU, a TI C64x™ Digital Signal Processor (DSP), and 1 GB of DDR2 SDRAM. The PandaBoard runs Linux®, including the traditional Ubuntu® or Android™ user environments and includes an SD Card slot, 3.5 mm audio connectors, Bluetooth®, wireless, and Ethernet connectivity. It can output video signals via DVI or HDMI interfaces. The PandaBoard is one of the easiest and most cost-efficient ways for universities to get their hands on a multi-core platform.

**ARM Cortex-A9 Dual-Core NVIDIA® Tegra 250™**

The NVIDIA Tegra 250 board integrates a dual-core Cortex-A9 MPCore processor, a 3D OpenGL® ES2.0 graphics processor, an image signal processor, an ultra-low-power audio processor, and Advanced Power management with reset/recovery buttons. Tegra 250 is one of the latest high-end ARM platforms, and it is available in a variety of today’s cutting-edge products such as tablets and powerful smartphones. As these represent only a subset of the Cortex-A8 processor-based platforms available from suppliers, other options are mentioned in the Development Platforms section of the ARM University Program web pages.
Classic ARM Processor Development Platforms

For universities interested in using classic ARM processor boards, such as those based on the ARM7™ or ARM9E processors, more information and platform suggestions are described in the Development Platforms section of the ARM University Program web pages.

ARM Cores used in many of the Classic Development Platforms

ARM7 Processors

The ARM7 family is a range of 32-bit Reduced-Instruction-Set-Computer (RISC) processors with more than 170 silicon licensees and over 10 billion units shipped since its introduction in 1994. The family features a 3-stage pipeline execution unit to provide exceptional area efficiency with very low-power consumption. The Cortex-M processor series has a newer embedded design with significant technical enhancements, including greater efficiency, power, and features, but the ARM7 family continues to be licensed and implemented today in simple 32-bit devices, as well as used to teach a variety of undergraduate courses from assembly programming to embedded system design.

ARM9E Processors

The ARM9E processor continues to be deployed across a wide range of products and applications with over 250 plus silicon licensees, making it the industry standard for cost-sensitive, DSP-enhanced, 32-bit RISC processors. ARM9E processors have been proven well suited for microcontroller, DSP, and Java applications, as well as university courses/projects.

ARM Mali-Development Platforms

ARM Mali™ graphic processor-based development platforms provide complete, cutting-edge solutions for 2D and 3D embedded graphics and video projects. The ARM Mali Developer Center freely accompanies all Mali platforms by bringing together a growing community of developers, technology partners, software vendors, and content companies for online collaboration.

Listed below are a few of the ARM Mali-graphic processor based development platforms available from third-party suppliers to interested universities.

ARM Mali STMicroelectronics-Ericsson MOP500

The ST-Ericsson MOP500 is a powerful development platform built around the first integrated baseband and application core using the latest SMP dual-core Cortex-A9 processor combined with the Mali-400 GPU for hardware accelerated 2D and 3D graphics. It is the ideal solution for embedded application development courses with multimedia capabilities that include an HD 1080p camcorder and an 18M pixel camera.

ARM Mali Telechips TCC8900

The TCC8900 is designed for digital multimedia applications based on the ARM1176JZF-S™ CPU and the Mali-200 3D graphics accelerator. It can be implemented in high-end multimedia entertainment devices such as car AVN, portable multimedia players, and home entertainment systems with a 1080p HDMI output.

As these represent only a subset of the ARM Mali-development platforms available from suppliers, other options are mentioned in the Development Platforms section of the ARM University Program web pages.
FPGA Development Platforms

FPGA development platforms are available from a variety of vendors to enable students and faculty to prototype complete systems, prove custom IP, and develop and test device drivers. The Cortex-M0 DesignStart processor can be freely downloaded and directly implemented into many FPGA boards to produce a powerful and customizable teaching tool.

The following are just a few of the many examples of FPGA development platforms available from third-party suppliers to interested faculty and students.

**Actel® SmartFusion™ with ARM Cortex-M3**

Even at a low cost, the Actel SmartFusion is a full-featured FPGA platform with a hardened Cortex-M3 processor and programmable analog logic. The SmartFusion can communicate via Ethernet or HyperTerminal and contains on-chip flash, SRAM memory as well as additional off-chip memory on the board. It also contains LEDs, switches, OLED, and room for extensive analog experimentation. SmartFusion is currently used in many university courses teaching microprocessor systems design.

**Xilinx® Zynq™ with dual-core Cortex-A9**

The Zynq-7000 combines a dual-core Cortex-A9 processor with Xilinx 28nm unified programmable logic architecture for the flexibility and scalability of an FPGA but with ASIC-like performance and the ease of use of an ASSP. It is the first available high-end, multi-core ARM processor delivered in an FPGA.

**Altera® LPRP with Cortex M1**

The Altera Low-Power Reference Platform (LPRP) allows the flexibility to create and demonstrate low-power solutions for portable, battery-powered embedded systems based on the Cortex-M1 processor.

As these represent only a subset of the FPGA platforms available from suppliers, other options are mentioned in the Development Platforms section of the ARM University Program web pages.

**Debug and Trace Adapters**

A separate, compatible debug adapter is sometimes needed for development with ARM-based platforms. However, more and more ARM-based platforms are being made available with integrated, on-board debugging capabilities eliminating the need for such external hardware.

Some platforms have real-time data access and instruction trace capability for systems that must be debugged in real-time without stopping the system, and a physical trace interface will likely be needed for this purpose.

The following are just a few of the many debug and trace interfaces available from ARM, Keil (an ARM company), and third-party suppliers.

**ARM-JTAG Wiggler®**

The ARM-JTAG Wiggler (sku: PGM-00275 from Sparkfun Electronics) is just one example of a simple, low-cost, parallel port-to-JTAG programmer/debugger for ARM microcontrollers. It uses ARM's standard 2x10 pin JTAG connector and requires no external power supply by taking all its needed power from the target board. The ARM-JTAG Wiggler provides students with everything a high priced emulator can do and more, including real-time emulation, debugging, and step-by-step program execution.

**Keil ULINK™ Family of Interfaces**

The Keil ULINKpro™ allows students to program, debug, and analyze their ARM7, ARM9, and Cortex-M processor-based applications with real-time data and instruction trace streaming via USB.

The Keil ULINK2® supports various ARM7, ARM9, and Cortex-M processor-based devices with a JTAG speed up to 10MHz and can be used for on-chip or flash memory debugging.

The Keil ULINK-ME® offers a subset of the ULINK2 features and is normally only provided with Keil or OEM Starter Kits. It supports both the standard 20-pin JTAG and 10-pin Cortex Debug connectors.

As these represent only a subset of the JTAG debuggers and tracers available from suppliers, other options are mentioned in the Development Platforms section of the ARM University Program web pages.

As an IP company, ARM does not manufacture processors; therefore, ARM offers only a few of the available development boards directly. The ARM University Program assists educational institutions in finding the most suitable platforms and tools through third-party suppliers and distributors (e.g., Mouser and Digi-Key). To find out more about pricing or view more detailed information on these and other examples of available hardware development platforms, please visit the link below:


Questions about development boards or debuggers?

Email us at: university@arm.com
Development Tools

Through the ARM University Program Development Tools web page, academic institutions can acquire a wealth of information and links to a variety of software tools for MCUs, Linux® application development, and application processors. These tools maximize the potential in hardware development platforms while supporting students throughout their project's development process with debuggers, compilers, and simulation models.

MDK-ARM

The ARM Keil™ Microcontroller Development Kit (MDK-ARM) is the recommended software solution for students working with most of the Cortex-M, ARM7, or ARM9 processor-based MCU devices. It features the industry-standard compiler from ARM, the Keil µVision® IDE, and sophisticated debug and data trace capabilities. A free evaluation of the MDK-ARM is available from the Keil website which features everything from the full commercial version with a 32 KByte object code/data limit. For educational purposes and simple experimentation with ARM processors (even without the need for hardware), the MDK-ARM evaluation is ideal.

ARM Development Studio 5™

The ARM Development Studio 5 (DS-5™) is a complete suite of professional software development tools for ARM Linux-based systems and is freely available to qualified universities. The DS-5 accelerates software application development by providing a well integrated, validated, and supported toolchain. This toolchain includes intuitive, easy to use graphical interfaces that provide all the information required for students to debug and optimize custom software for ARM processor-based ASICs. It is the ideal tool set for developing Linux applications in simulation or on a target board such as the BeagleBoard or Freescale i.MX Quick Start board.

RVDS

The ARM RealView® Development Suite (RVDS) is designed for quick and efficient software development and can be used in both graduate and undergraduate programs. Although more expensive than MDK or DS-5, RVDS supports the entire range of ARM Cortex processors.

ARM Fast Models

Created to accelerate software development prior to silicon availability, ARM provides Fast Models that help students and faculty debug, analyze, and optimize their applications throughout the development cycle. These extensively validated programmer’s-view models allow early access to an ARM processor-based Virtual Platform that runs at speeds comparable to real silicon and is suitable for software development. ARM Fast Models are currently available to universities directly from ARM at academic rates, or through distributors like Europractice found online through the University Program web pages.

Other Open-source and Third-party Tools

Many other software development tools exist that can be useful to academics. Examples include open-source tools from Linaro® and GNU, as well as low-cost or free, industry-standard tools such as CodeComposer Studio™ from TI, CodeWarrior Development Studio™ from Freescale, and tools from IAR®.

Linaro brings together the open source community and the electronics industry to collaborate on key projects, deliver tools, reduce fragmentation, and provide common foundations for Linux software distributions.

The GNU tools provide a large body of free binary and source code packages for ARM processors that students can use to modify and build their own suite, with or without hardware.

Free for qualified students and faculty, CodeComposer Studio is an integrated development environment for TI’s ARM processor-based microcontrollers and application processors for developing and debugging embedded applications.

CodeWarrior Development Studio is a complete, integrated development environment by Freescale that provides a highly visual and automated framework to accelerate the development of the most complex embedded applications.

The IAR Embedded Workbench® is an integrated development environment with a C/C++ compiler for building and debugging ARM processor-based embedded applications.

More information and resources regarding these software development tools, fast models, and many other support products for academic institutions can be found in the Tools section of the ARM University Program web pages:

http://www.arm.com/support/university/tools.php

Questions about development tools?
Email us at: university@arm.com
Academic Resources

For students and faculty interested in example academic ARM projects, incorporating ARM into new or existing curricula, or simply gaining familiarity with ARM, the ARM University Program provides a variety of additional educational resources and materials. These resources include links to academic textbooks (not just technical reference manuals), teaching material, real ARM-based university course curriculum examples, guest lectures and technical workshops available from the ARM University Program, student design contests, information about supported and available operating systems, academic research papers, student application notes, podcasts, and more.

Textbooks

Links to textbooks for educational purposes are listed online, covering such topics as ARM assembly language, programming guides, SoC architecture, and tutorials on software and development. Only those textbooks identified as potential teaching material are included.

Lectures

A number of guest lectures, hands-on technical workshops, seminars, and faculty training courses are detailed online and available through the ARM University Program.

Design Contests

Design contests for students sponsored by ARM and ARM's partners will be posted periodically on the ARM University Program web pages. Students interested in competing in such contests should check the ARM University Program web pages regularly for updates on competition formats and prizes.

Sample Curricula

Many universities around the world have begun using ARM in their courses. Samples of ARM-based course curricula from prestigious educational institutions are available online for public viewing.

Other Resources

Other helpful resources on the ARM University Program web page include links to operating systems, example applications, research papers, step-by-step tutorials, real university lab manuals, and various instructional guides.

These academic resources and services are available to introduce higher education institutions to ARM technology and provide pathways to effectively implement ARM processors in the classroom. To request a lecture, download sample curricula, or acquire learning materials, please visit the link provided below.

http://www.arm.com/support/university/academic-resources.php

Questions about resources? Email us at: university@arm.com