

Getting Started with ARM Cortex M4 Architecture

What you will Learn

- ✓ ARM Cortex M4 Architecture(10 Min)
- ✓ STM32CUBE IDE (10 Min)
- ✓ Blinking LED (20 Min)

About Me

PANTECH SOLUTIONS

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M K Jeeva Rajan

🏆 Founder and Director, pantechsolutions, hub for makers and students, ❤️ Digital Marketing , Automation and Artificial Intelligence

Talks about #automation, #innovation, #embeddedsystems, #machinelearning, and #artificialintelliegence

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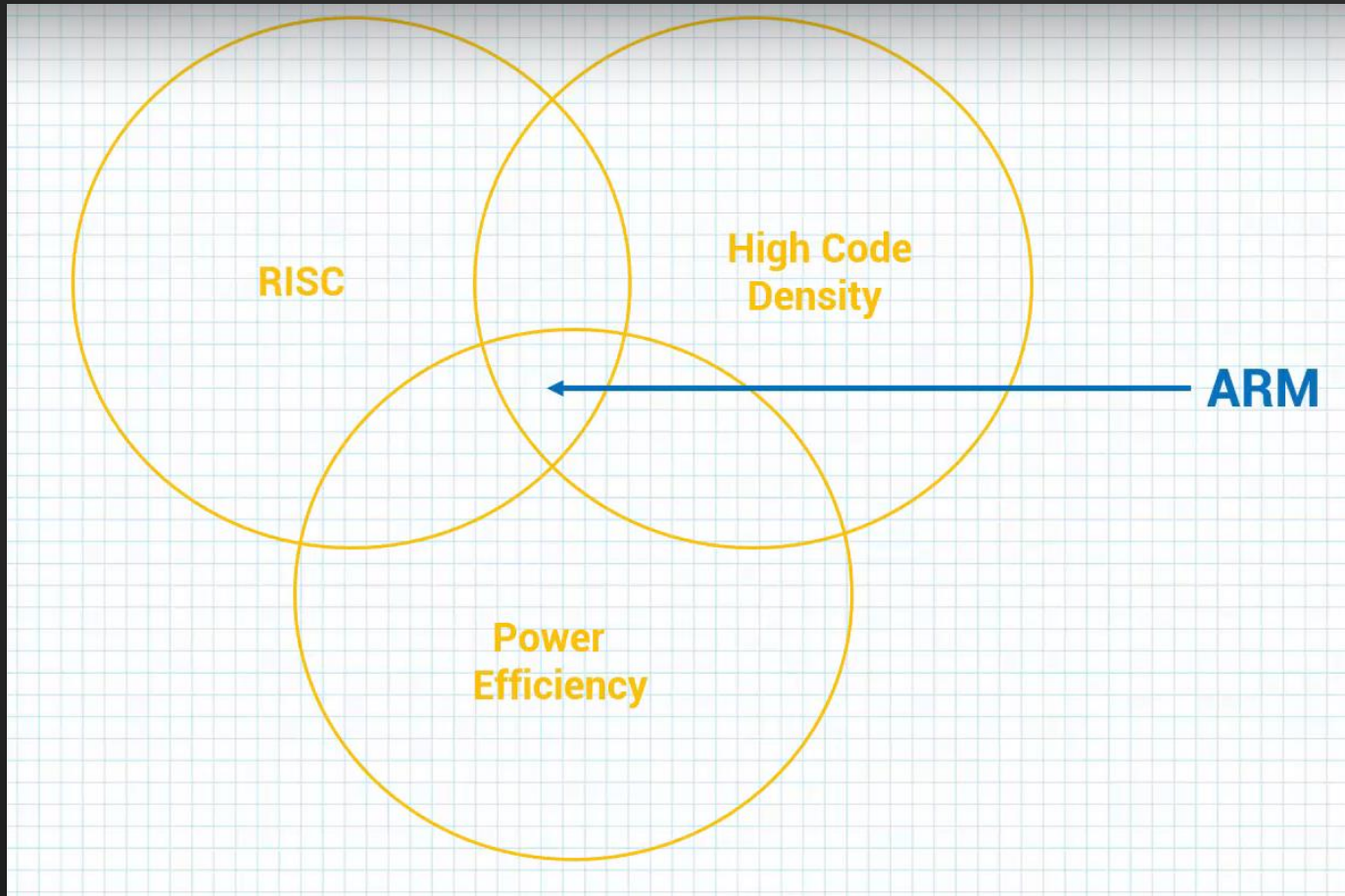
College of Engineering,
Guindy

- ✓ 18+Years of Experience
- ✓ Build 300+ Products
- ✓ Generated 70+Crores of Revenue
- ✓ Top 5 Innovation Products in India (Brainsense- NAASSCOM-2015)

<https://www.linkedin.com/in/jeevarajan/>

Are You Ready?

ARM Design Philosophy



ARM Vs INTEL

ARM

- RISC
- Little, Big Endian

INTEL

CISC

Little Endian

ARM Processor vs ARM Architecture

Arm architecture

- ✓ Describes the details of instruction set, programmer's model, exception model, and memory map
- ✓ Documented in the Architecture Reference Manual

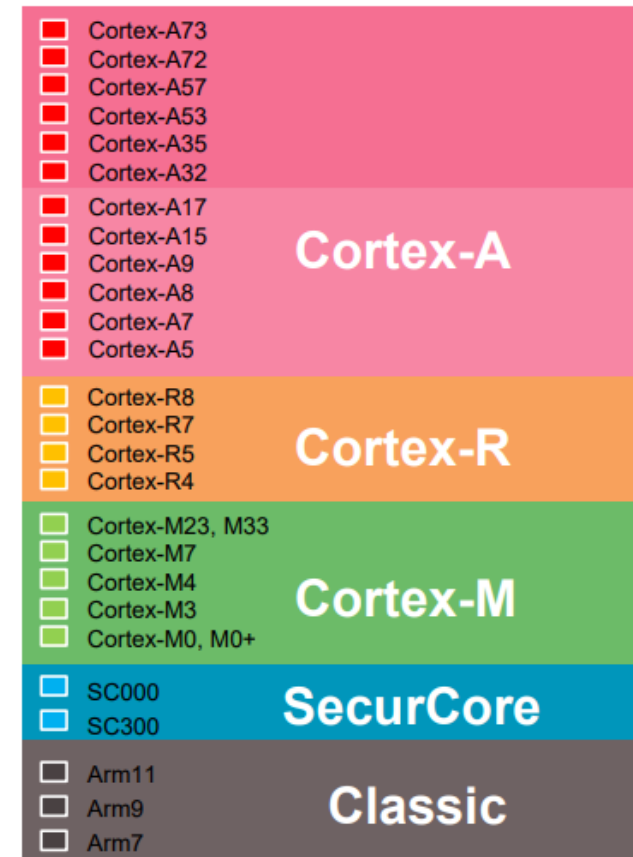
Arm Processor

- ✓ Developed using one of the Arm architectures
- ✓ More implementation details, such as timing information
- ✓ Documented in processor's Technical Reference Manua

https://en.wikipedia.org/wiki/List_of_ARM_processors

ARM Processor Families

- **Cortex-A series (Application)**
 - High performance processors capable of full Operating System (OS) support
 - Applications include smartphones, digital TV, smart books
- **Cortex-R series (Real-time)**
 - High performance and reliability for real-time applications;
 - Applications include automotive braking system, powertrains
- **Cortex-M series (Microcontroller)**
 - Cost-sensitive solutions for deterministic microcontroller applications
 - Applications include microcontrollers, smart sensors
- **SecurCore series**
 - High security applications
- Earlier classic processors including Arm7, Arm9, Arm11 families



Architecture Extensions

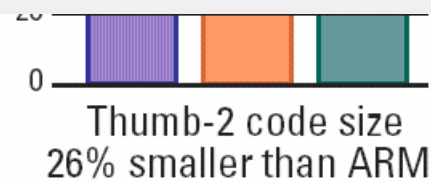
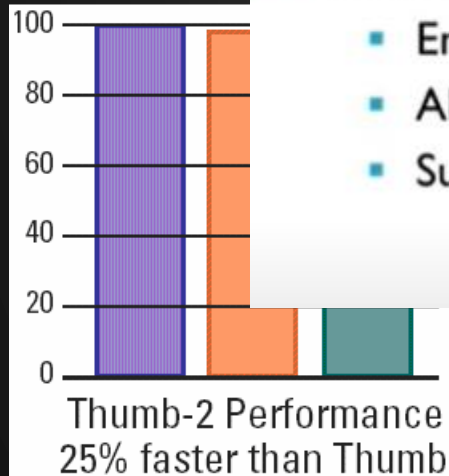
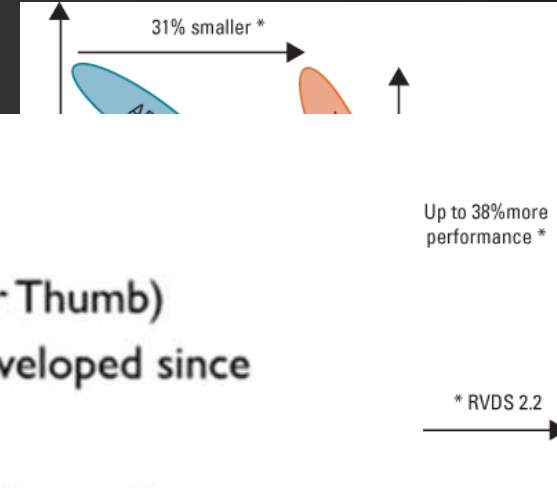
- Improved Code Density
- Improved Performance
- Power

Thumb®

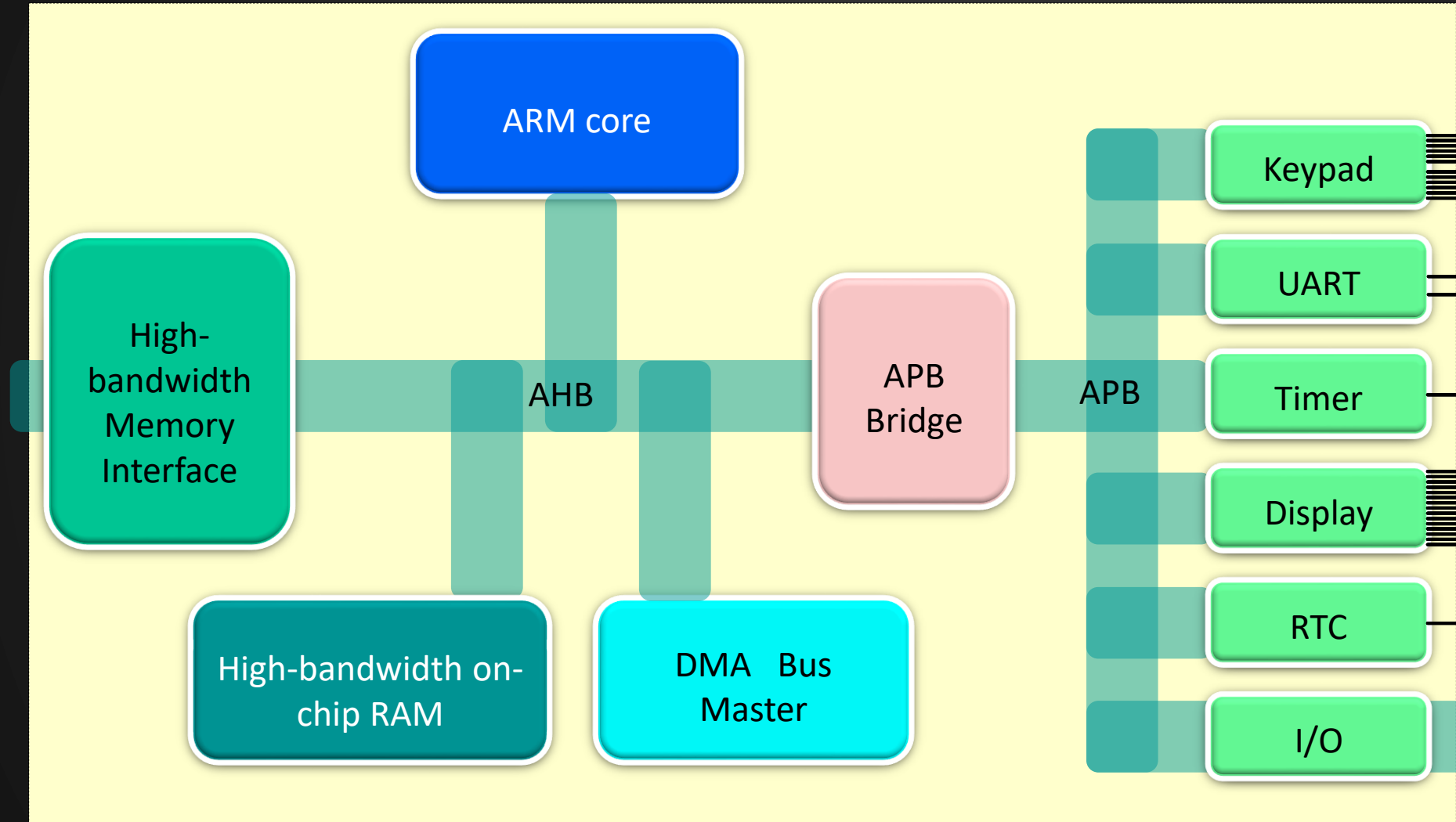
- 32-bit operations in 16-bit instructions
- Introduced in ARM7TDMI® processor ('T' stands for Thumb)
- Subsequently supported in every ARM processor developed since

Thumb-2

- Enables a performance optimised blend of 16/32-bit instructions
- All processor operations can all be handled in 'Thumb' state
- Supported across the Cortex®-M processor range



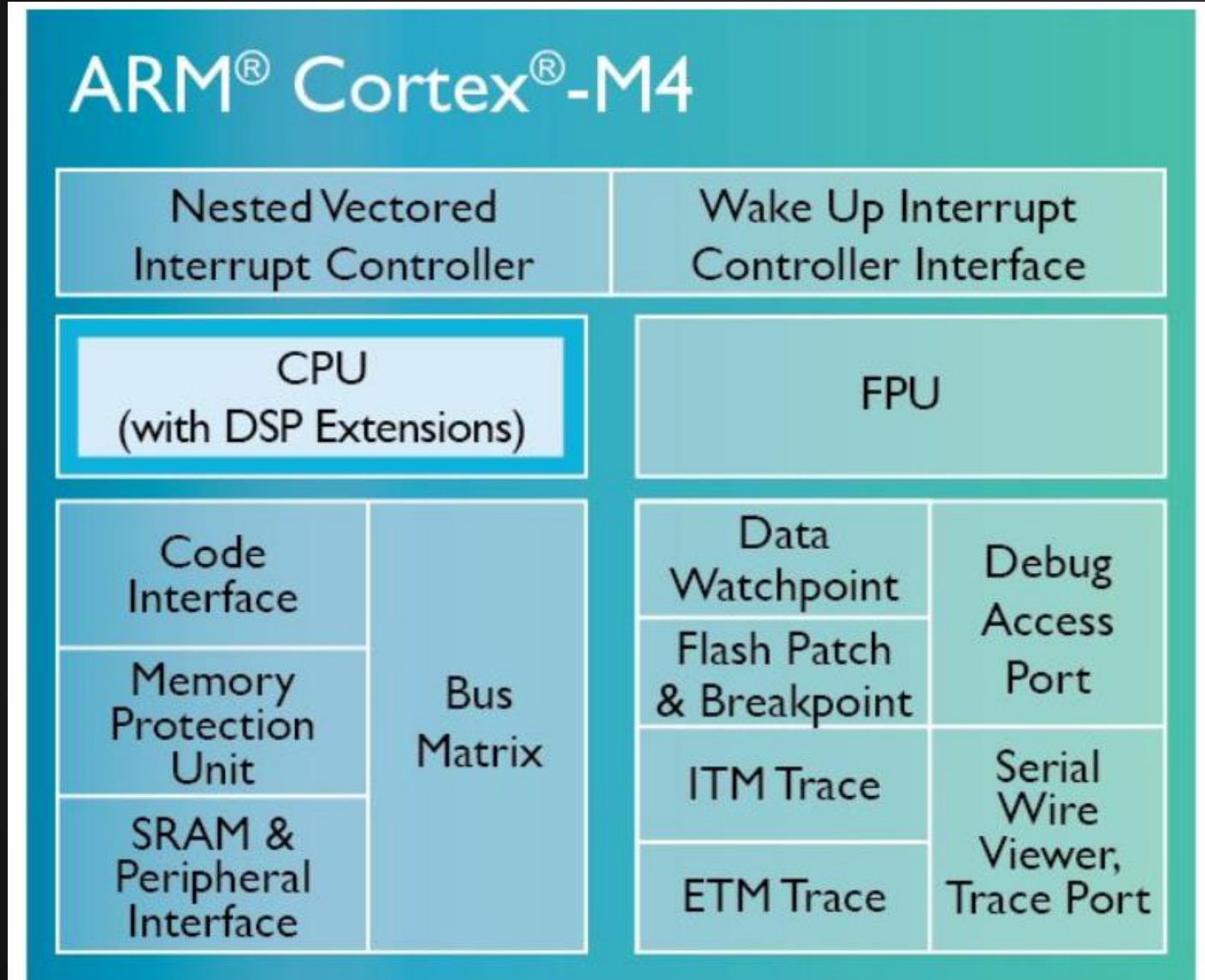
Example AMBA System



ARM Cortex-M Series Family

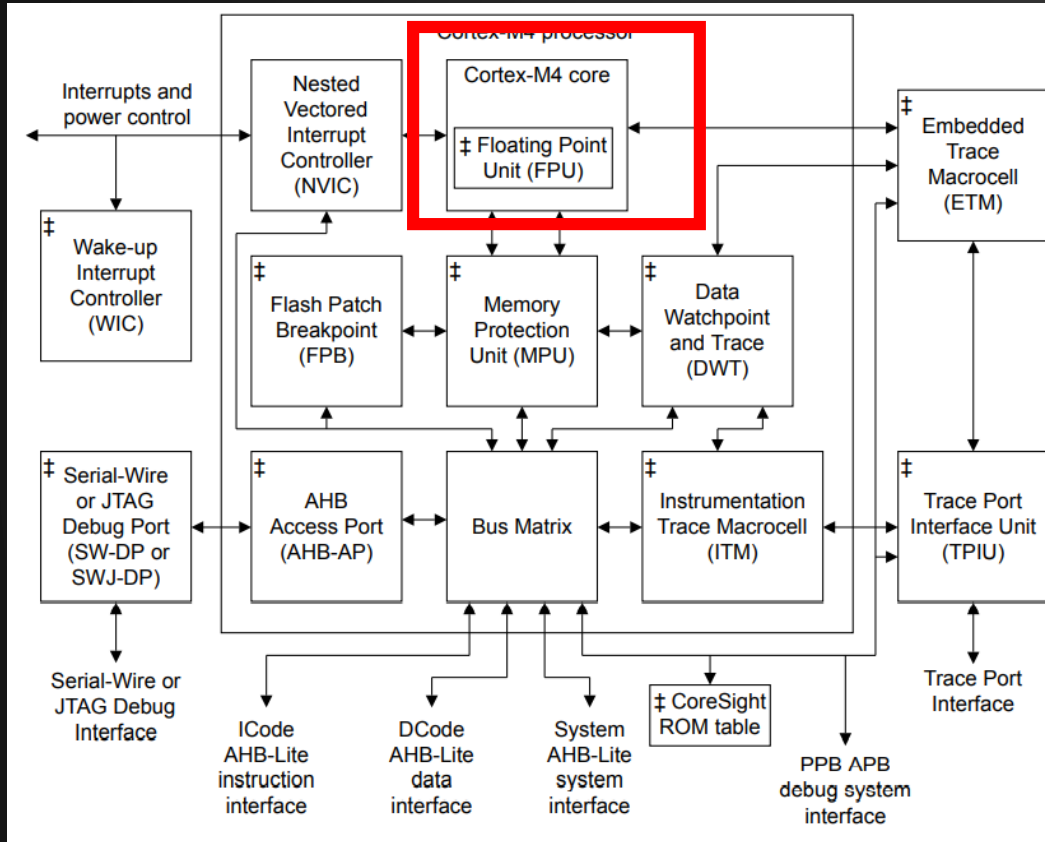
Processor	Arm Architecture	Core Architecture	Thumb®	Thumb®-2	Hardware Multiply	Hardware Divide	Saturated Math	DSP Extensions	Floating Point
Cortex-M0	Armv6-M	Von Neumann	Most	Subset	1 or 32 cycle	No	No	No	No
Cortex-M0+	Armv6-M	Von Neumann	Most	Subset	1 or 32 cycle	No	No	No	No
Cortex-M3	Armv7-M	Harvard	Entire	Entire	1 cycle	Yes	Yes	No	No
Cortex-M4	Armv7E-M	Harvard	Entire	Entire	1 cycle	Yes	Yes	Yes	Optional
Cortex-M7	Armv7E-M	Harvard	Entire	Entire	1 cycle	Yes	Yes	Yes	Optional
Cortex-M23, 33	Armv8-M	Harvard	Entire	Entire	1 cycle	Yes	Yes	Yes	Optional

ARM Cortex-M4



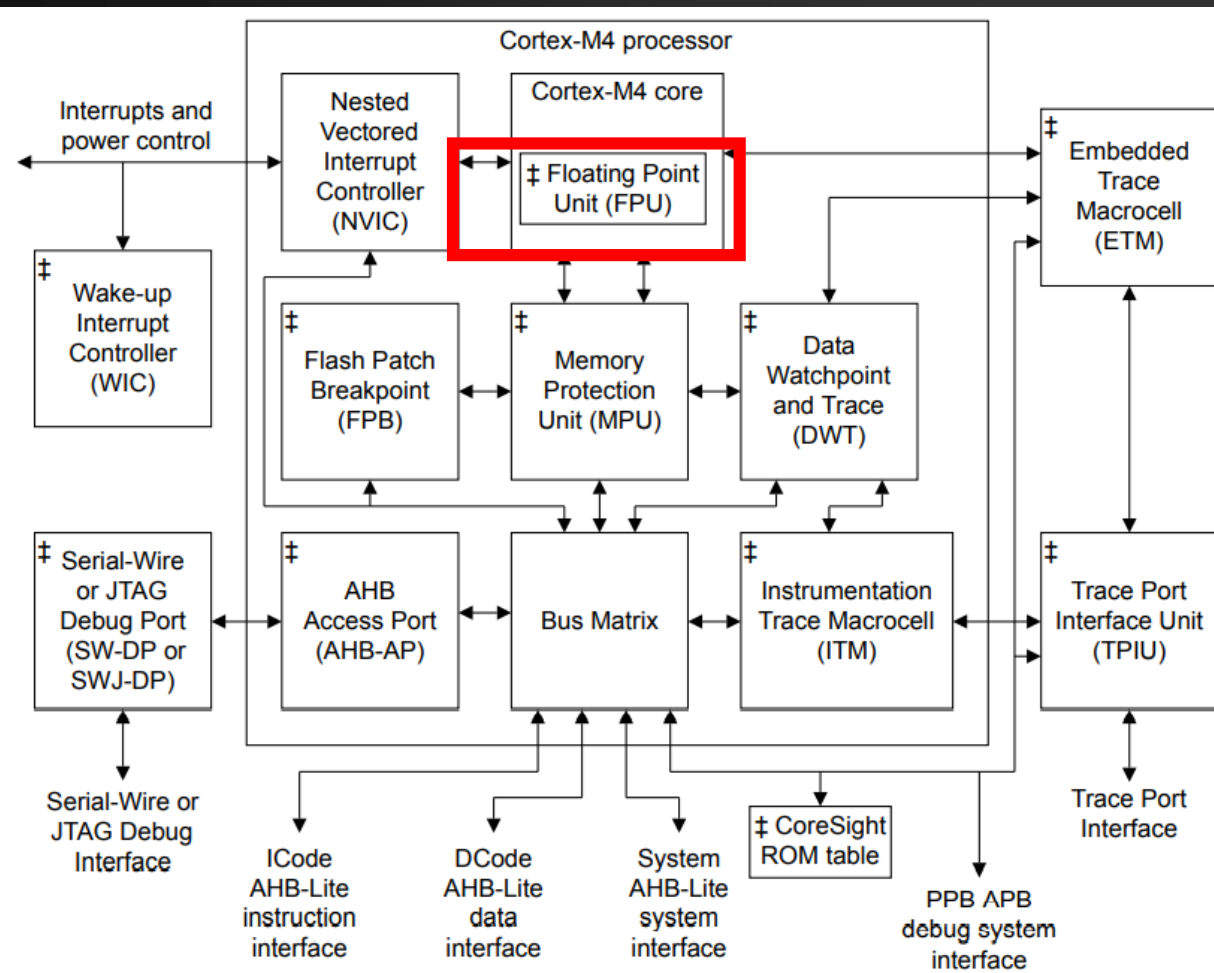


Processor Core Features



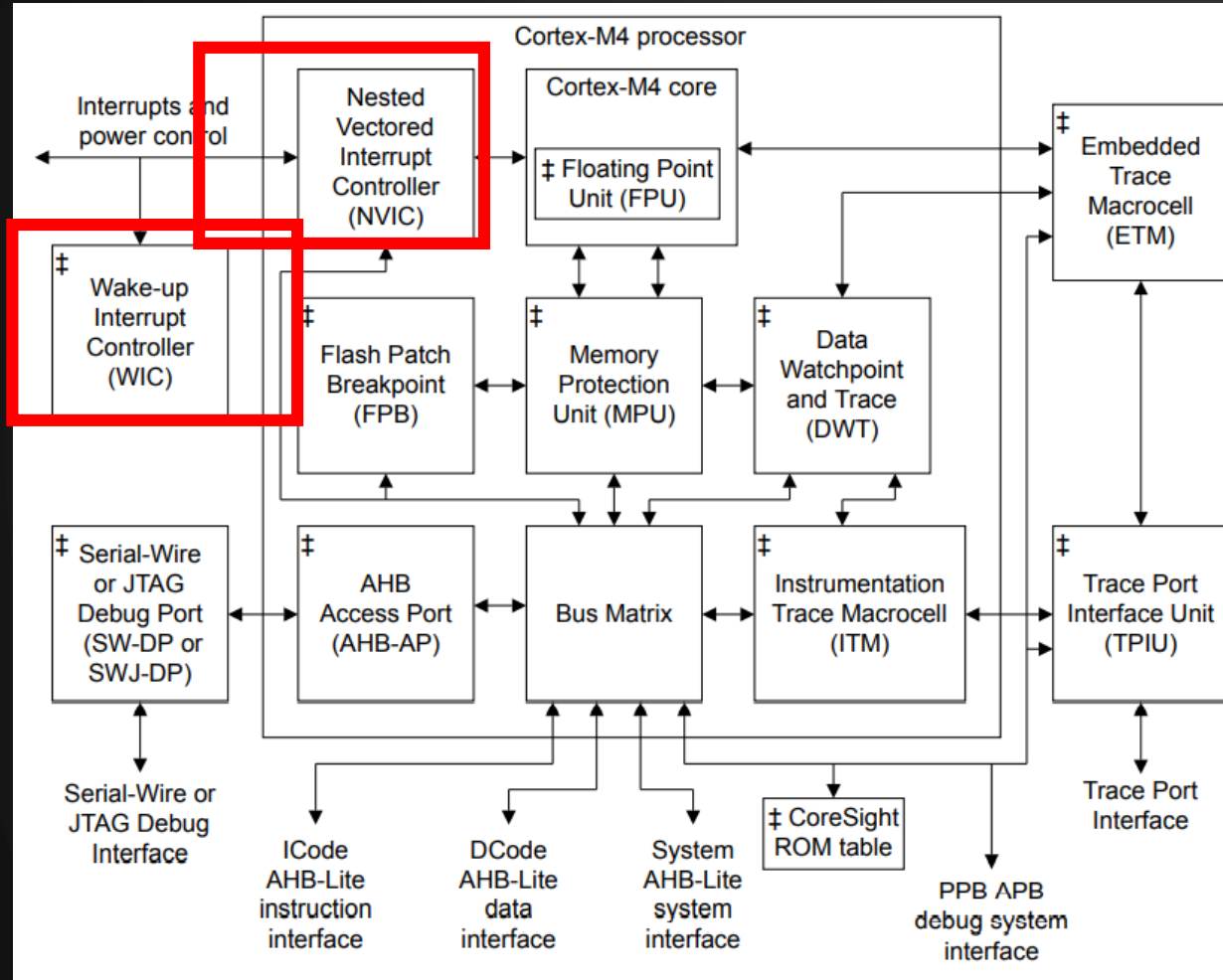
- A subset of the Thumb instruction set, defined in the ARM®v7-M Architecture.
- Banked Stack Pointer (SP).
- Hardware integer divide instructions, SDIV and UDIV.
- Handler and Thread modes.
- Thumb and Debug states.
- Support for interruptible-continued instructions LDM, STM, PUSH, and POP for low interrupt latency.
- Automatic processor state saving and restoration for low latency Interrupt Service Routine (ISR)
- Support for ARMv6 big-endian byte-invariant or little-endian accesses.

Floating Point Unit



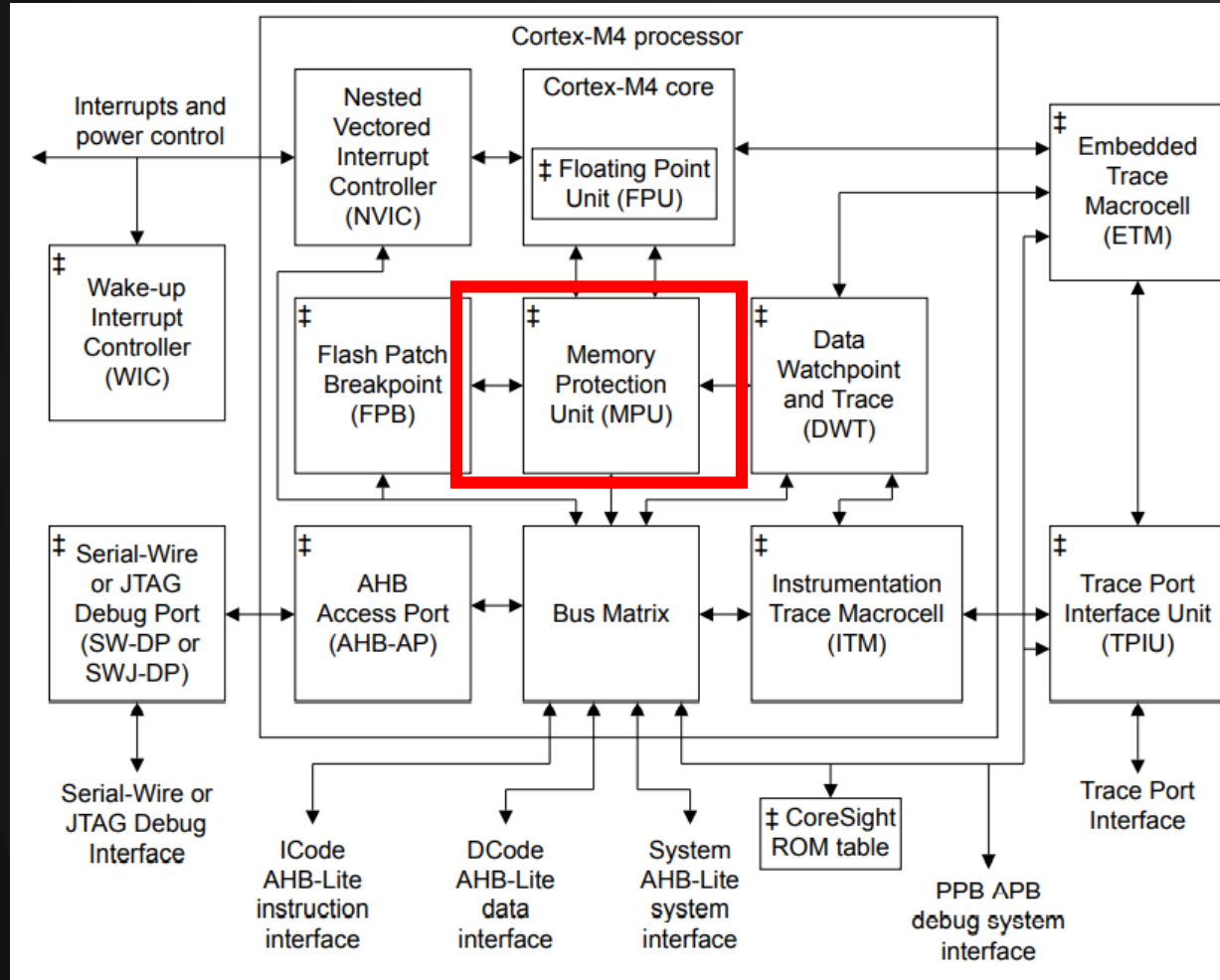
- 32-bit instructions for single-precision (C float) data-processing operations.
- Combined Multiply and Accumulate instructions for increased precision (Fused MAC).
- Hardware support for conversion, addition, subtraction, multiplication with optional accumulate, division, and square-root.
- IEEE rounding modes.
- 32 dedicated 32-bit single-precision registers, also addressable as 16 double-word registers.

NVIC



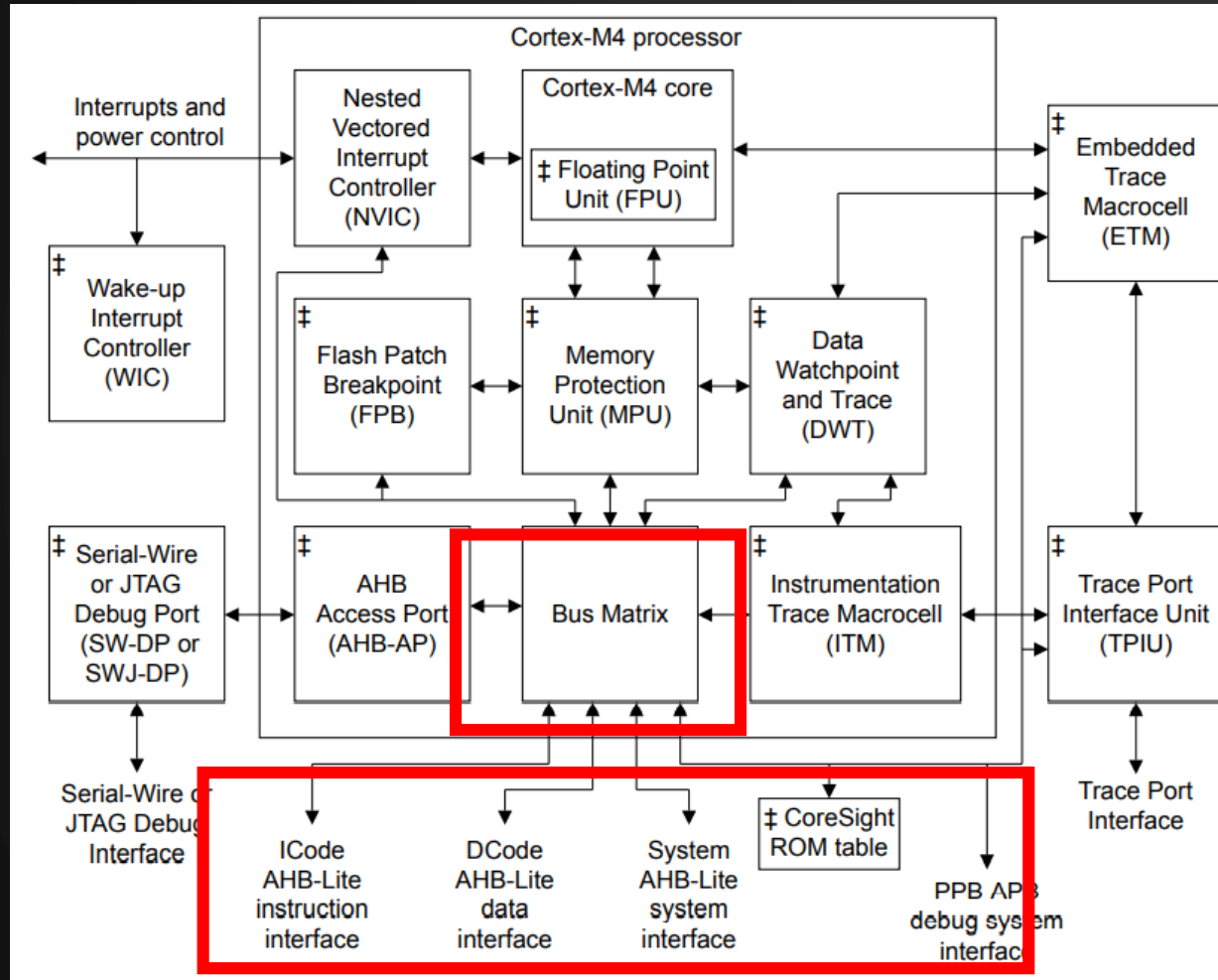
- Low latency interrupt processing.
- External interrupts, configurable from 1 to 240.
- Bits of priority, configurable from 3 to 8.
- Dynamic reprioritization of interrupts.
- Priority grouping. This enables selection of preempting interrupt levels and non preempting interrupt levels.
- Processor state automatically saved on interrupt entry, and restored on interrupt exit, with no instruction overhead.
- Optional Wake-up Interrupt Controller (WIC), providing ultra-low-power sleep mode support.

MPU



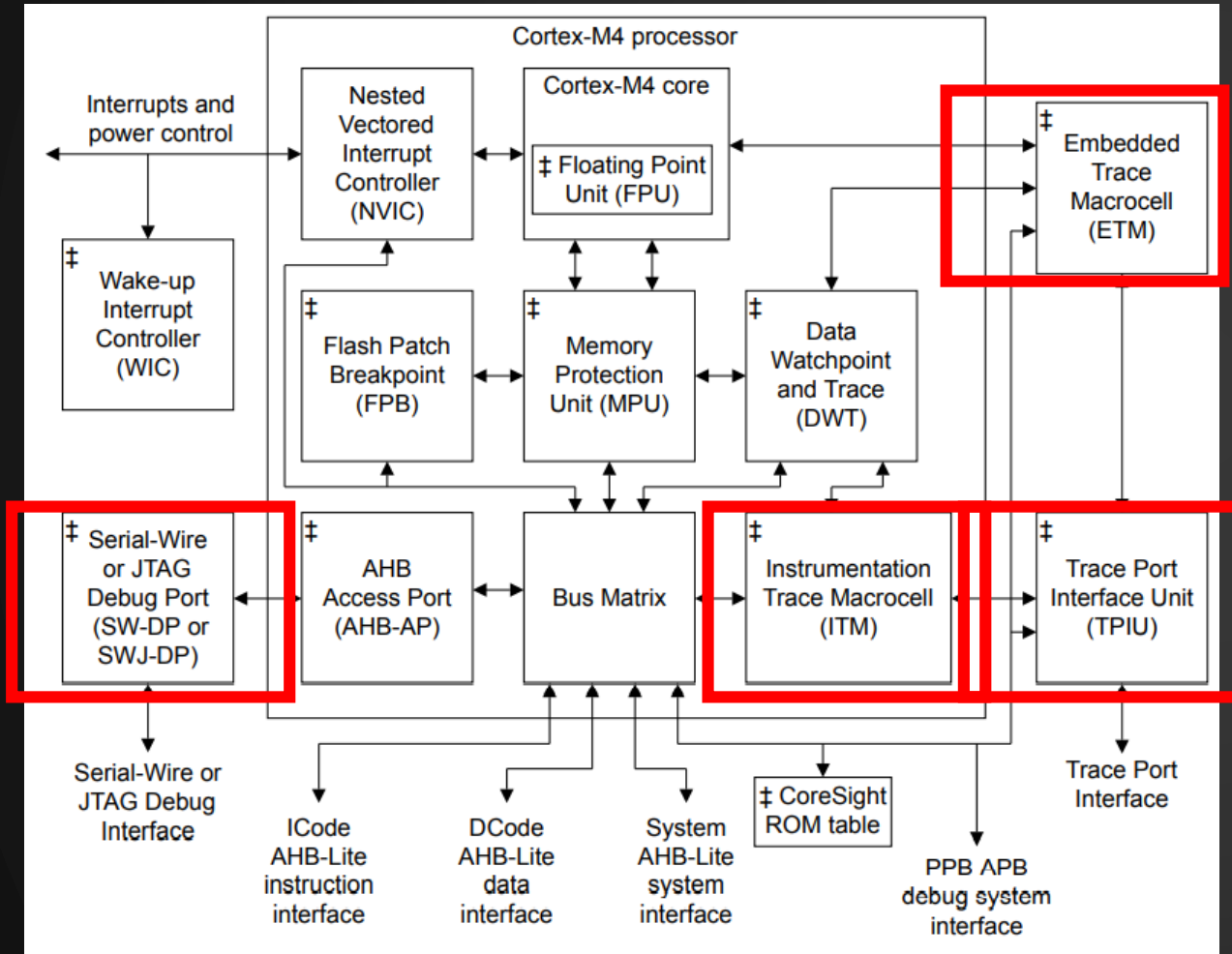
- Prevents application task from corrupting OS or other task data
 - Improves system reliability
- Eight memory regions.
- Sub Region Disable (SRD), enabling efficient use of memory regions.
- The ability to enable a background region that implements the default memory map attributes.

Interfaces



- Three Advanced High-performance Bus-Lite (AHB-Lite) interfaces: ICode, DCode, and System bus interfaces.
- Private Peripheral Bus (PPB) based on Advanced Peripheral Bus (APB) interface.

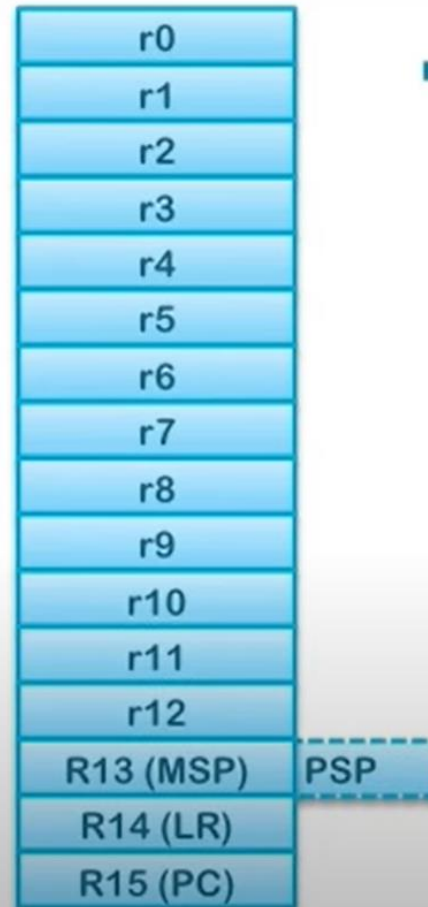
Debug Features



- **Serial Wire Debug Port (SW-DP) or Serial Wire JTAG Debug Port (SWJ-DP) debug access.**
- **Optional Flash Patch and Breakpoint (FPB) unit for implementing breakpoints and code patches.**
- **Optional Data Watchpoint and Trace (DWT) unit for implementing watchpoints, data tracing, and system profiling.**
- **Optional Instrumentation Trace Macrocell (ITM) for support of printf() style debugging.**
- **Optional Trace Port Interface Unit (TPIU) for bridging to a Trace Port Analyzer (TPA), including Single Wire Output (SWO) mode.**
- **Optional Embedded Trace Macrocell (ETM) for instruction trace.**

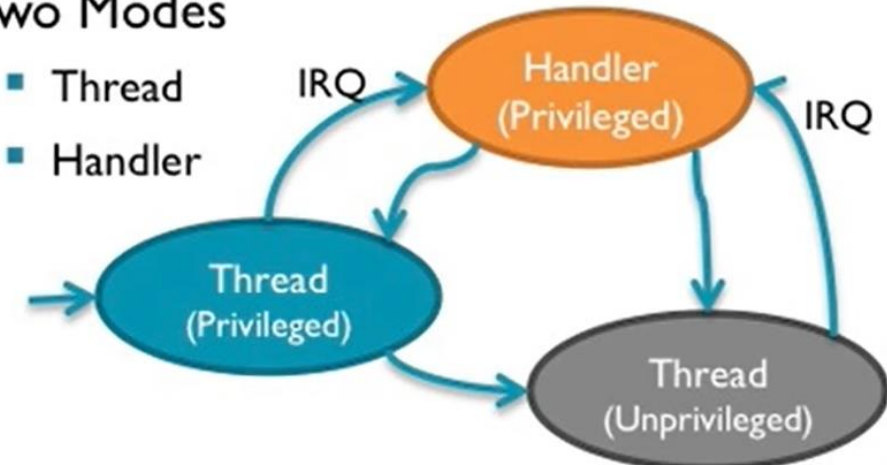
Baseline Programmers Model

- Register banks
 - R0 to R15
 - R13 – Stack Pointers
 - R14 – Link Register
 - R15 – Program Counter
- Special registers
 - Program Status Registers (PSR)
 - CONTROL
 - PRIMASK
 - Cortex-M3/M4/M7 have additional mask registers



- Two Modes

- Thread
- Handler



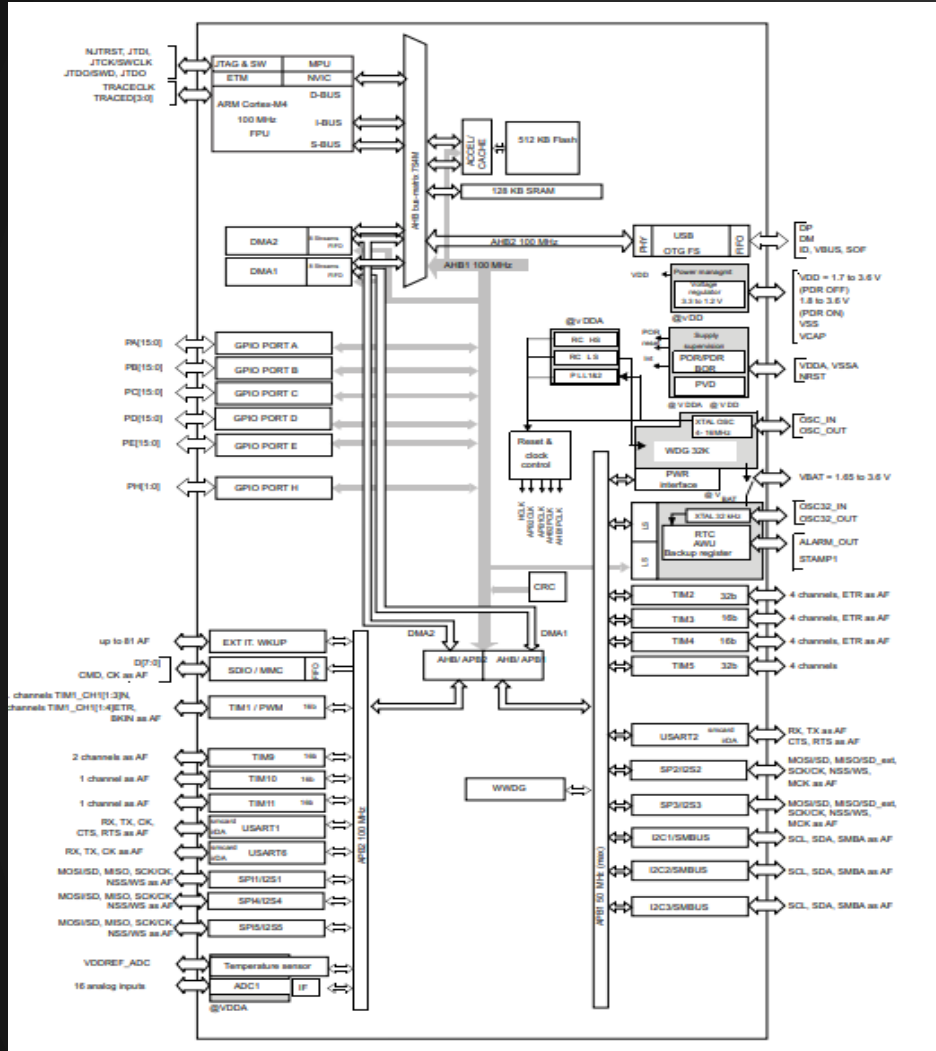
(Not available in Cortex-M0)



- Two Levels

- Privileged
- Unprivileged

STM2F411 Block Diagram.

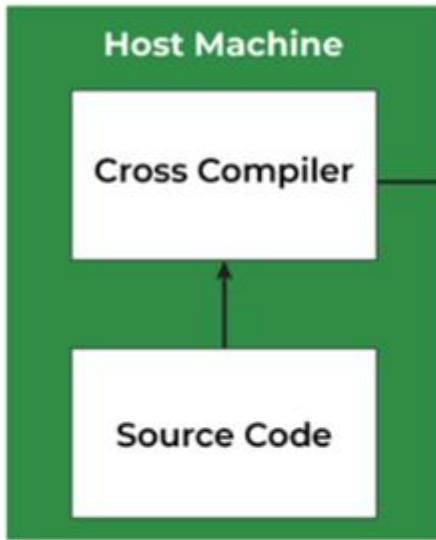


<https://www.st.com/resource/en/datasheet/stm32f411re.pdf>

PAGE NO 15

Cross Compiler

X86/X64 Architecture



ARM Architecture



.hex / .bin / .elf

What is IDE

- ✓ Compiler, Assembler, linker, Loader
- ✓ Editor Window, Console window, Project window
- ✓ Debug/ Release
- ✓ Memory window
- ✓ Register window
- ✓ Break points, Watch points
- ✓ Debugger
- ✓ Programming Options

Download the IDE

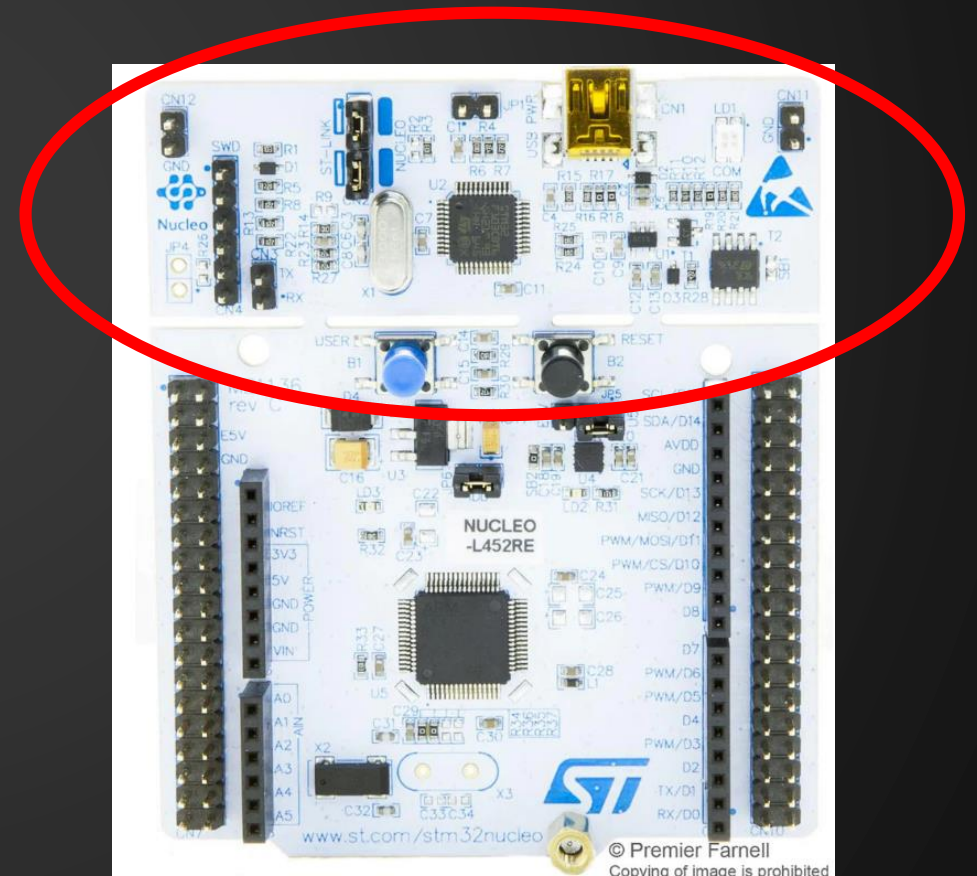
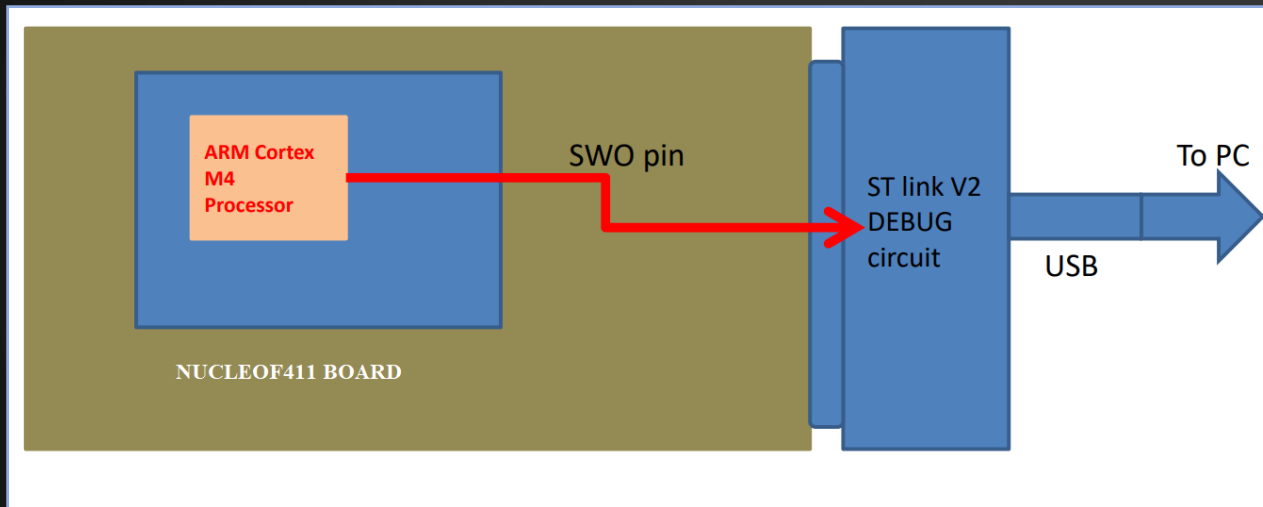
✓STM32CUBEIDE

<https://www.st.com/en/development-tools/stm32cubeide.html>

Get the Latest Link

	Part Number ▲	General Description ◆	Supplier ◆	Download ◆	All versions ◆
+	STM32CubeIDE-DEB	STM32CubeIDE Debian Linux Installer	ST	Get latest	Select version ▼
+	STM32CubeIDE-Lnx	STM32CubeIDE Generic Linux Installer	ST	Get latest	Select version ▼
+	STM32CubeIDE-Mac	STM32CubeIDE macOS Installer	ST	Get latest	Select version ▼
+	STM32CubeIDE-RPM	STM32CubeIDE RPM Linux Installer	ST	Get latest	Select version ▼
+	STM32CubeIDE-Win	STM32CubeIDE Windows Installer	ST	Get latest	Select version ▼

Creating a Project in Target using STM32CUBEIDE

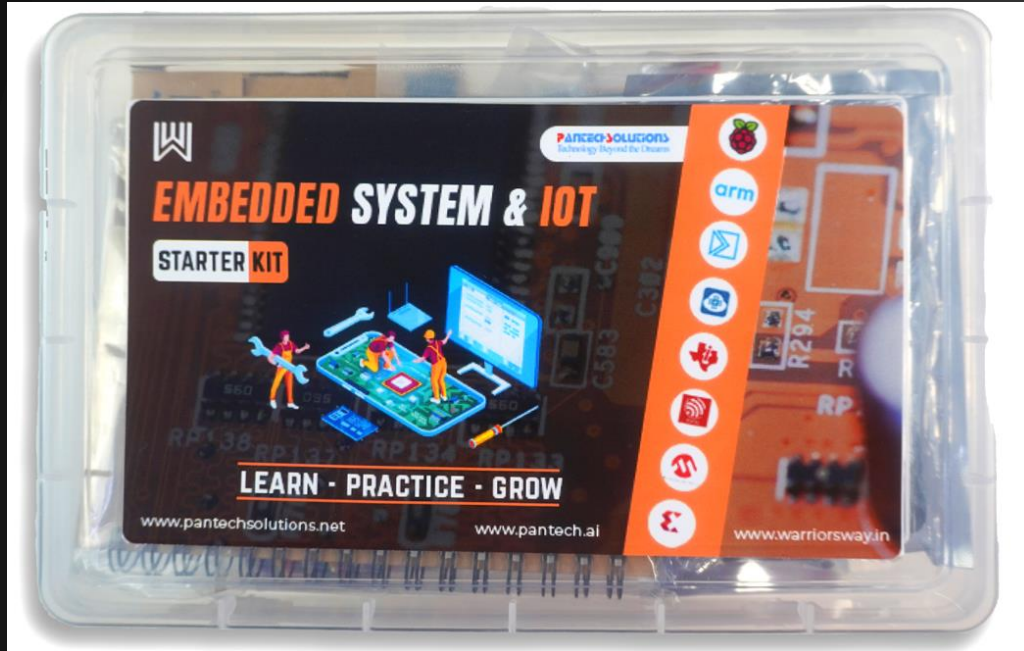


Embedded Code Debugging Options

- Serial Wire viewer
- Single stepping, Stepping Over and Stepping out
- Break Points
- Disassembly
- Call stack
- Expression and Variable Windows
- Memory Browser
- Data Watchpoints
- SFR Windows
- Other Basic Features of IDE

BLINKING LED DEMO

ESD/IOT STARTER KIT



Rs 8258

(Inclusive of GST)
Shipment in 10 Days



STM32F411RE NUCLEO



Nodemcu 8266 x1



Logic Analyzer



USB cable x2



ADXL345 x1



DHT11 x1



Led x1



4X4keypad x1



Relay module x1



Hc-05 x1



LCD x1

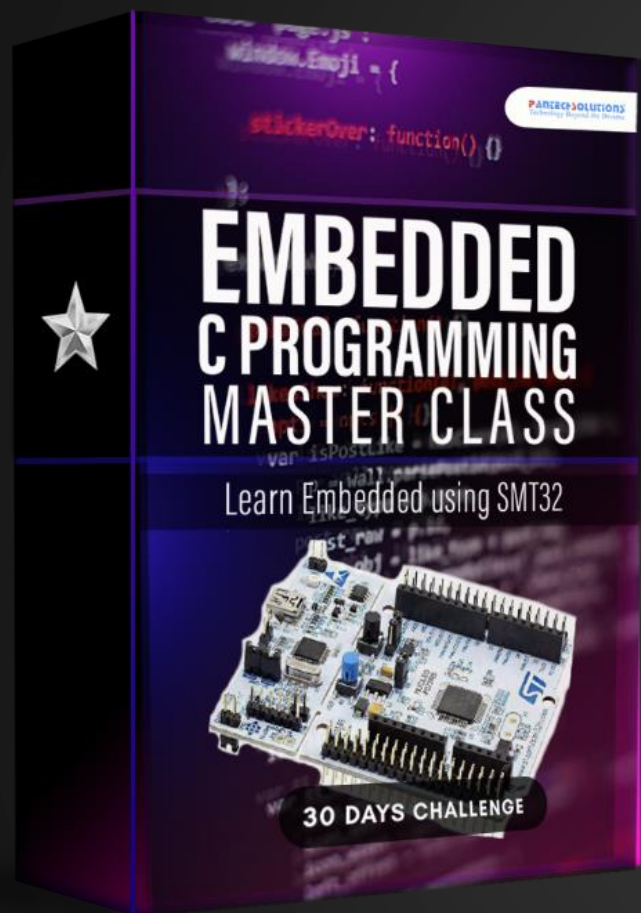


Breadboard x1



Jumper wire x1

<https://rzp.io/l/mWQk5qiszl>

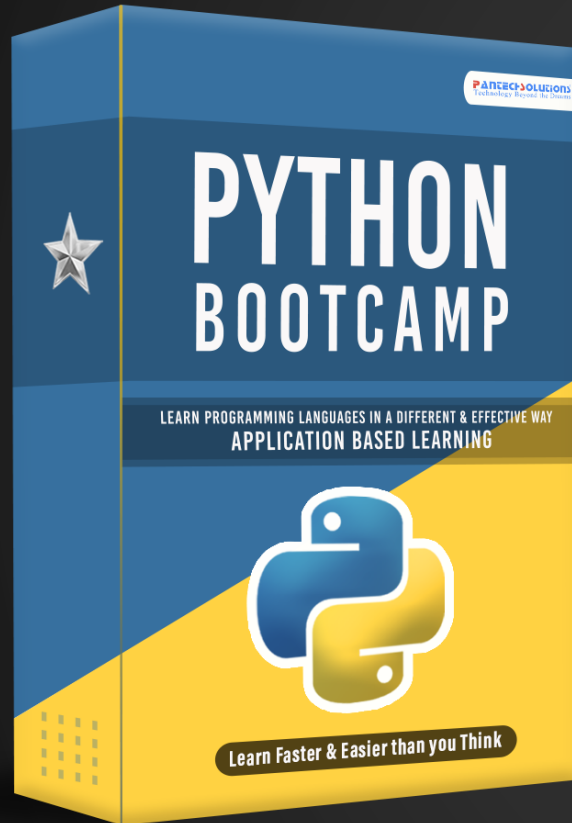


Embedded C Master Class

30 Days Challenge

5+ Projects

₹1499 VALUE



₹999 VALUE

Python Master Class

10 Days Challenge

5+ Categories

Objects – Data Structures – Functions –
Decorators – Generators – Images – Files –
Additional modules

Embedded System & IOT Master Class



8051 – ARM7 – Cortex M4(LPC4088) – PIC – NodeMCU – ESP32

30 Days Challenge • 5+ Peripherals 5+ Projects

₹1499 VALUE



Embedded System ARM Cortex M4 Master Class

30 Days Challenge • 5+ Peripherals 2+ Projects

₹1499 VALUE

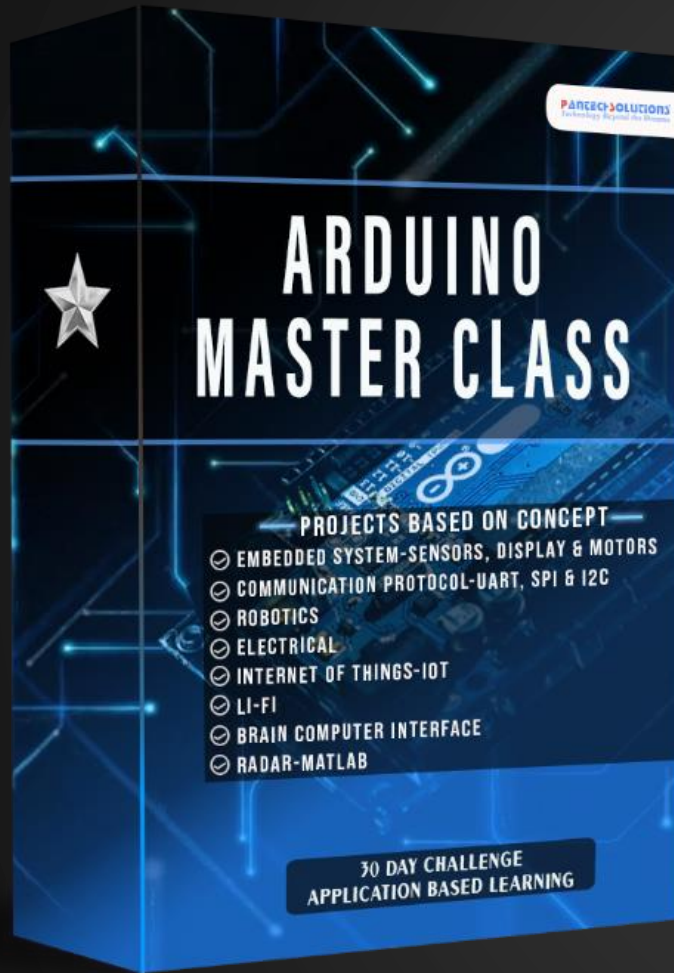


IOT Master Class

30 Days Challenge • 5+ Projects

Azure – AWS – Thingspeak etc

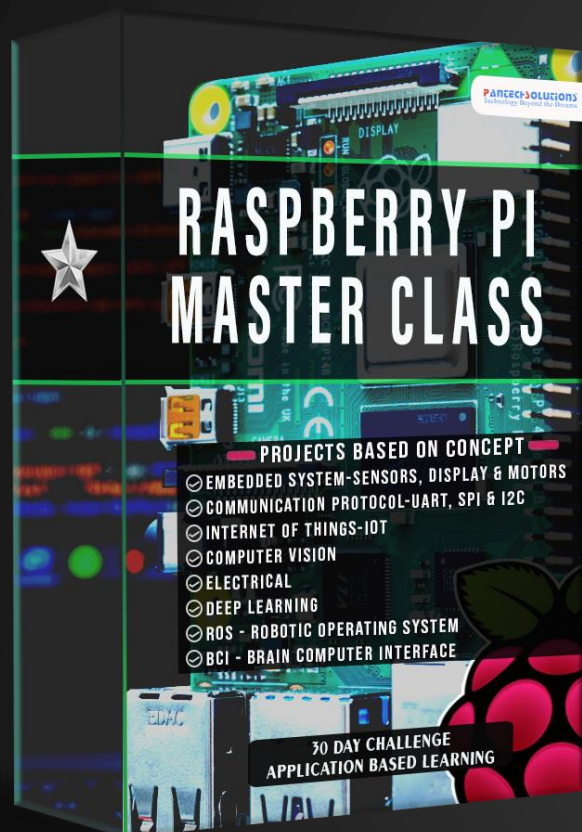
₹1499 VALUE



Arduino Master Class

30 Days Challenge • 5+ Projects

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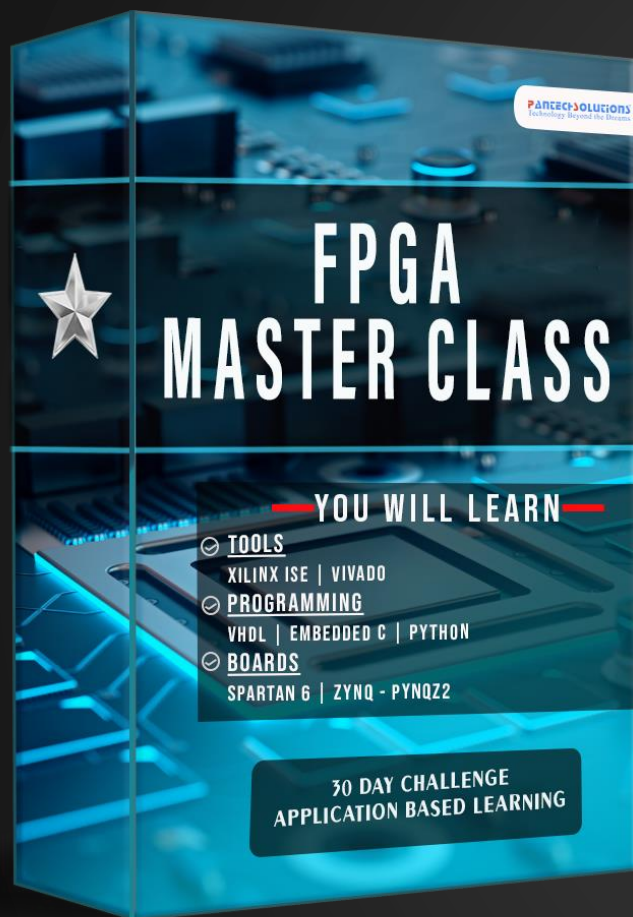


Raspberry Pi Master Class

30 Days Challenge • 5+ Projects

Sensors – Display – BCI – IoT – Robots -
Computer vision – ROS – Deep Learning – Voice
assistance

₹1499 VALUE

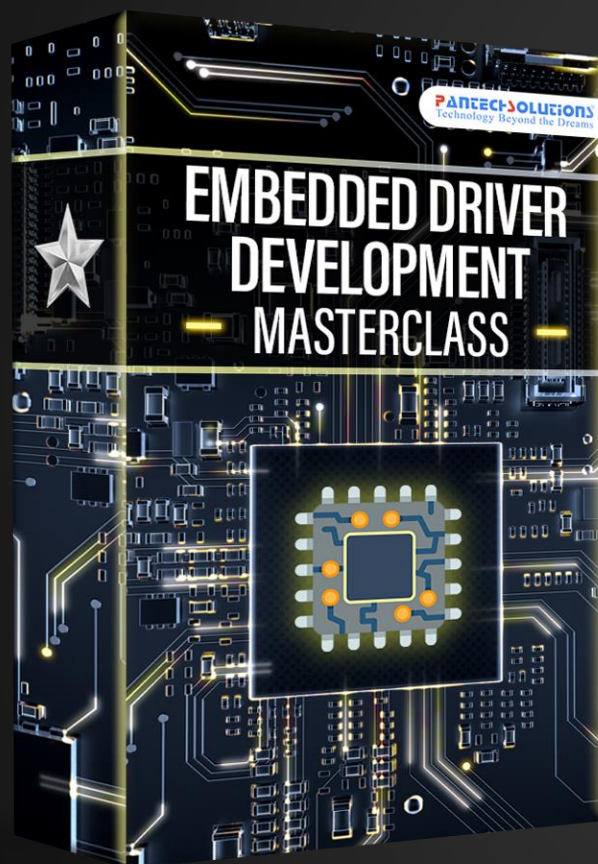


FPGA Master Class

VHDL – VERILOG – SPARTAN 6 - ZYNQ

21 Days Challenge • 5+ Projects

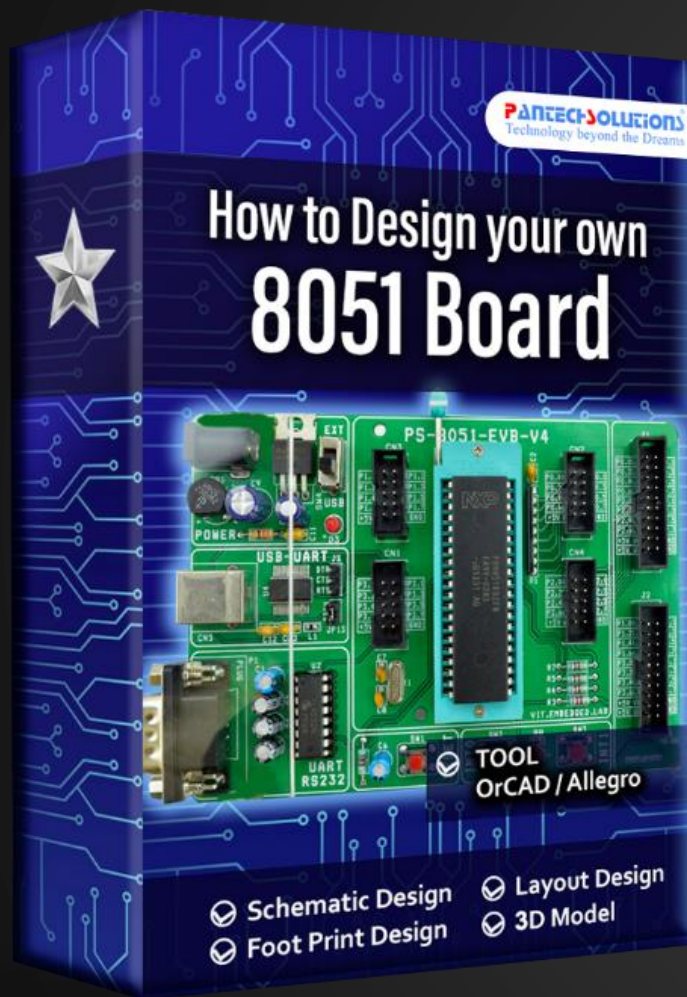
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Embedded Driver Development Master Class

30 Days Challenge

₹1499 VALUE

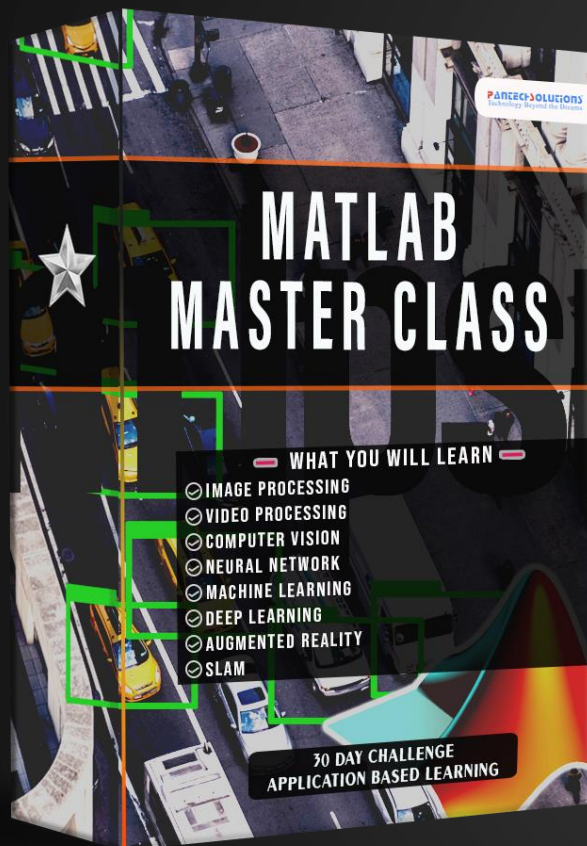


Schematic & PCB Design Master Class

12 Days Challenge

₹999 VALUE

11



Matlab Master Class

Image/Video Processing – Computer Vision –
Neural Network – Augmented Reality - SLAM

30 Days Challenge

₹999 VALUE

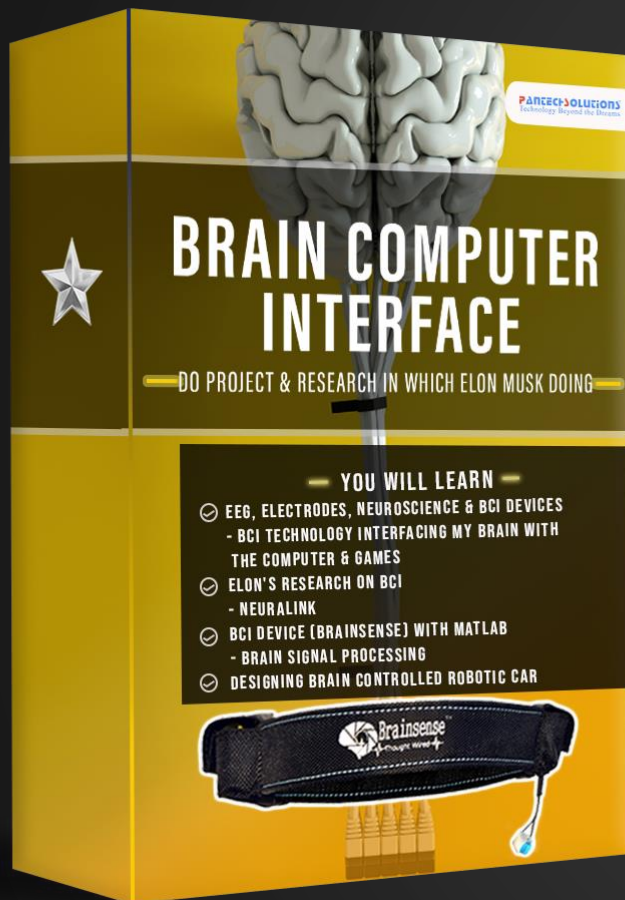


AI USING MATLAB Master Class

SVM – KNN – CNN – RCNN – Machine Learning
– Jetson Nano

15 Days Challenge

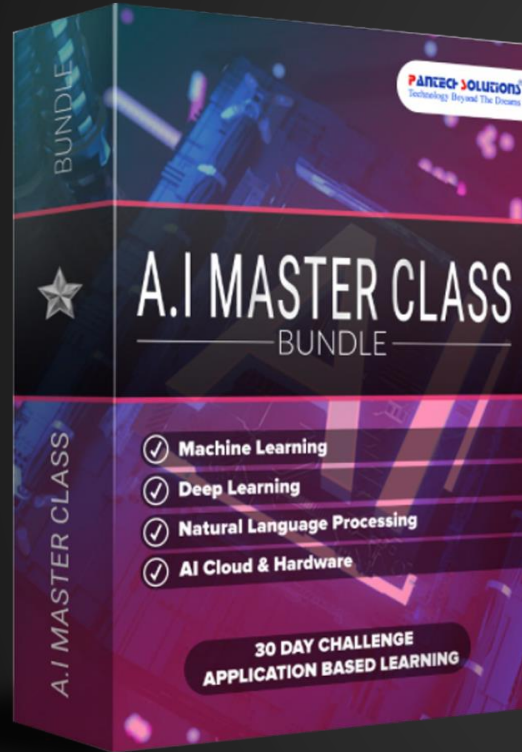
₹999 VALUE



Brain Computer Interface

- How it Works
- How to control an LED using BCI
- How to read Attention Levels and Meditation

₹999 VALUE

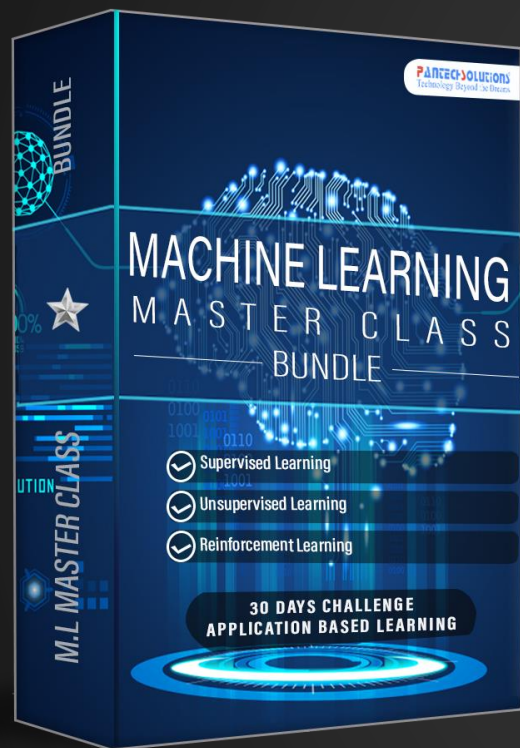


Artificial Intelligence Master Class

Chatbot – Python – Machine Learning – Deep Learning – NLP – A.I using Cloud – A.I using Hardware

30 Days Challenge • 25+ Projects • 7+ Concepts

₹2499 VALUE



Machine Learning Master Class

Supervised Learning – Unsupervised Learning – Reinforcement Learning

30 Days Challenge • 28+ Projects • 3 Categories

₹2499 VALUE

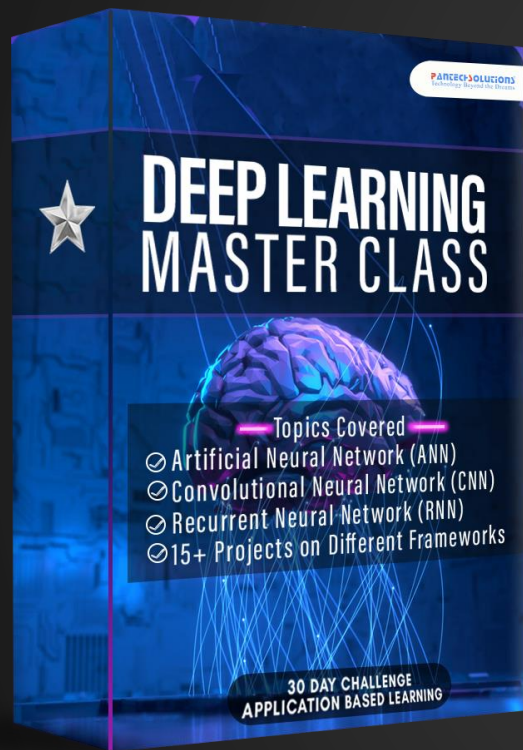


Data Analytics Master Class

Excel – Statistics – BI Tools – Python – Database – ML - DL

30 Days Challenge • 10+ Projects • 5+ Core Parts

₹2499 VALUE

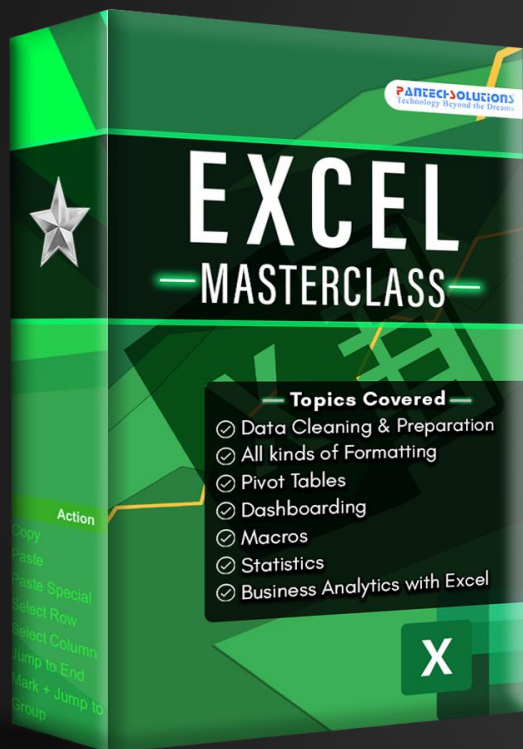


Deep Learning Master Class

Projects using different computer vision & Neural Network techniques, Algorithms etc.

30 Days Challenge • 15+ Projects

₹2499 VALUE



Excel Master Class

Data Cleaning – Formula - Pivot Table - Graphs & Charts -Validation & Publishing -VBA Macros –
Dashboards – Advanced Bonus

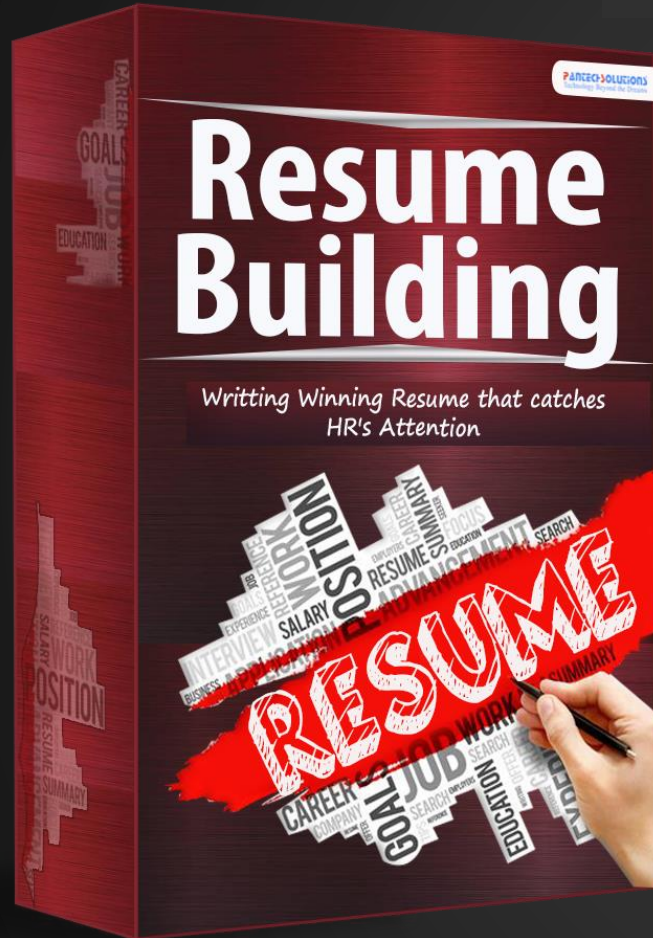
30 Days Challenge • Industry Needed Concept

₹2499 VALUE

ACTUAL VALUE
~~₹29482/Yr~~

Rs 9999
(Inclusive of GST)

14



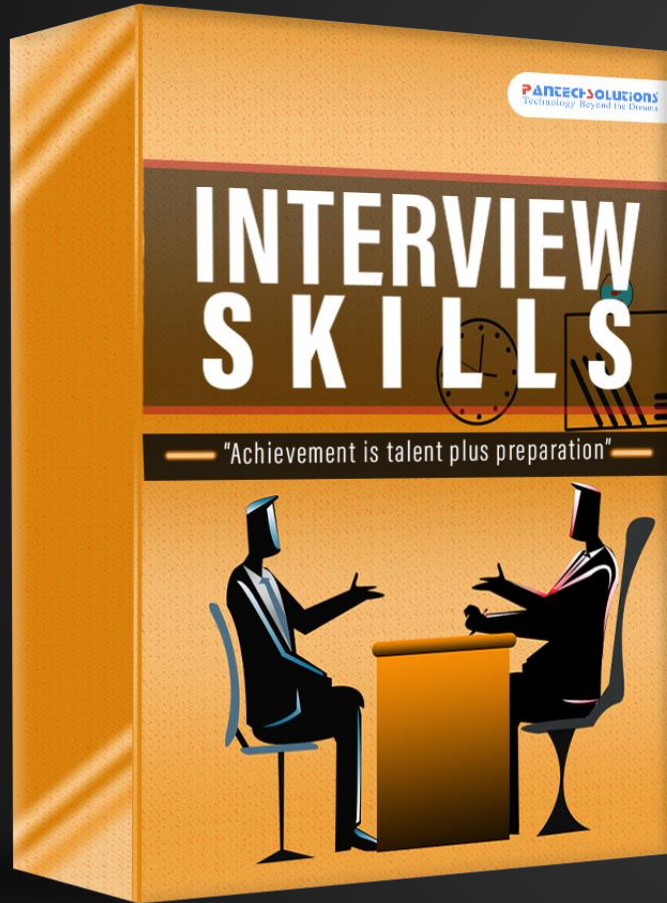
Resume Building Mastery

- ✓ How to write a Killer Resume
- ✓ How to write a resume for ATS

~~₹499 VALUE~~

FREE

15



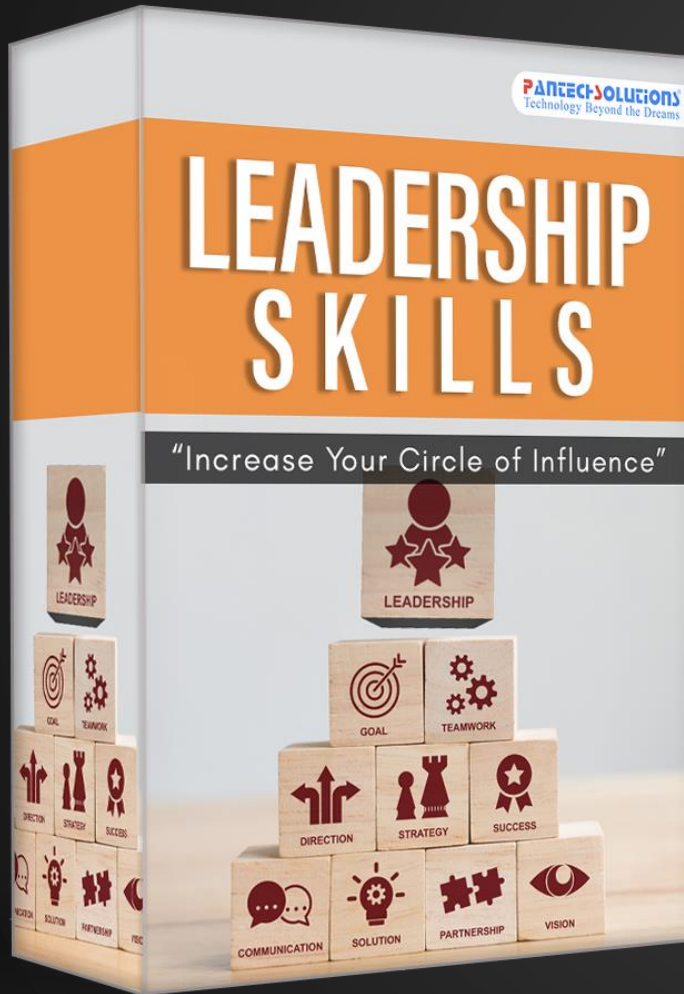
Interview Skills Mastery

- Self-preparation
- Research
- Mastering your emotions
- Logistical planning
- Communication
- Introducing yourself
- Presenting your qualifications
- Listening.

~~₹499 VALUE~~

FREE

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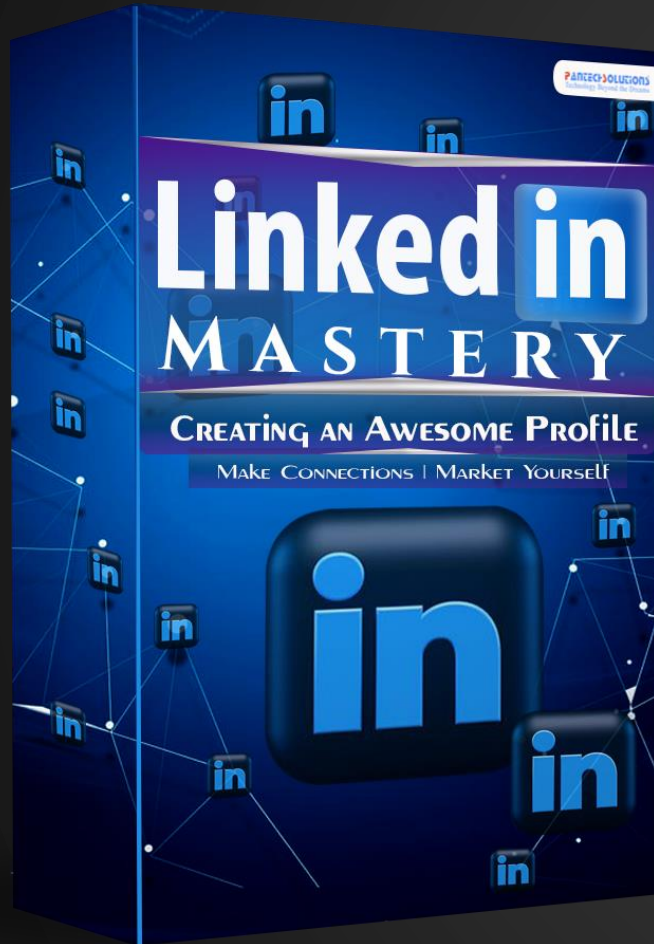
Leadership Skills Mastery

- Leadership Styles
- Leadership Levels
- Becoming a Leader

~~₹499 VALUE~~

FREE

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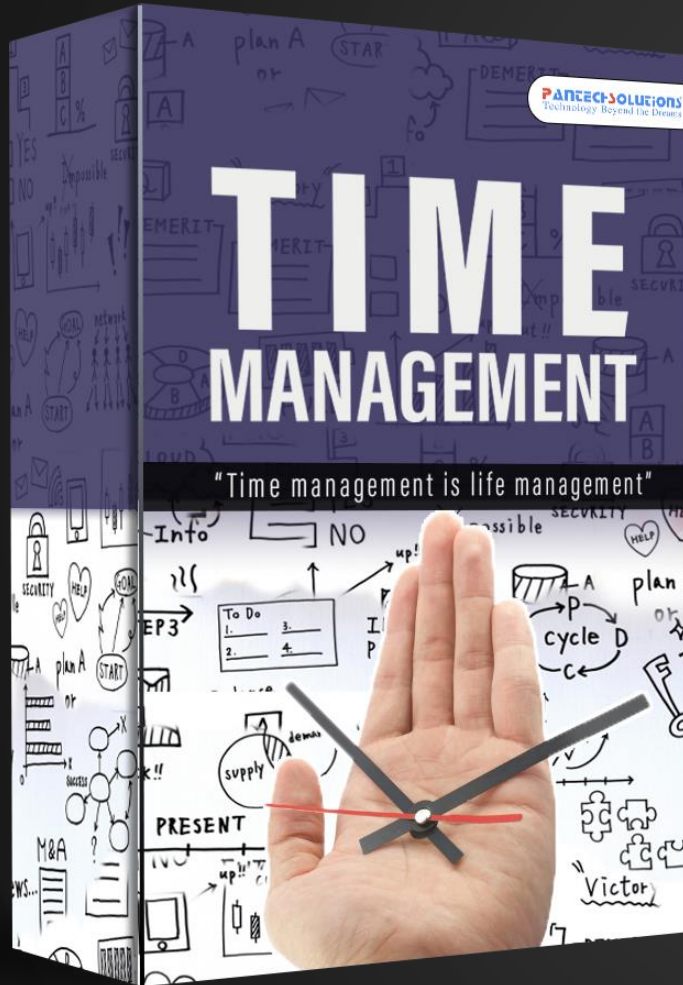
LinkedIn Mastery

- LinkedIn Optimization
- How to use LinkedIn
- Leveraging LinkedIn Premium

~~₹499 VALUE~~

FREE

17



Time Management Mastery

- How to Plan your Day
- How to utilize your Time
- What is the value of your time

~~₹499 VALUE~~

FREE



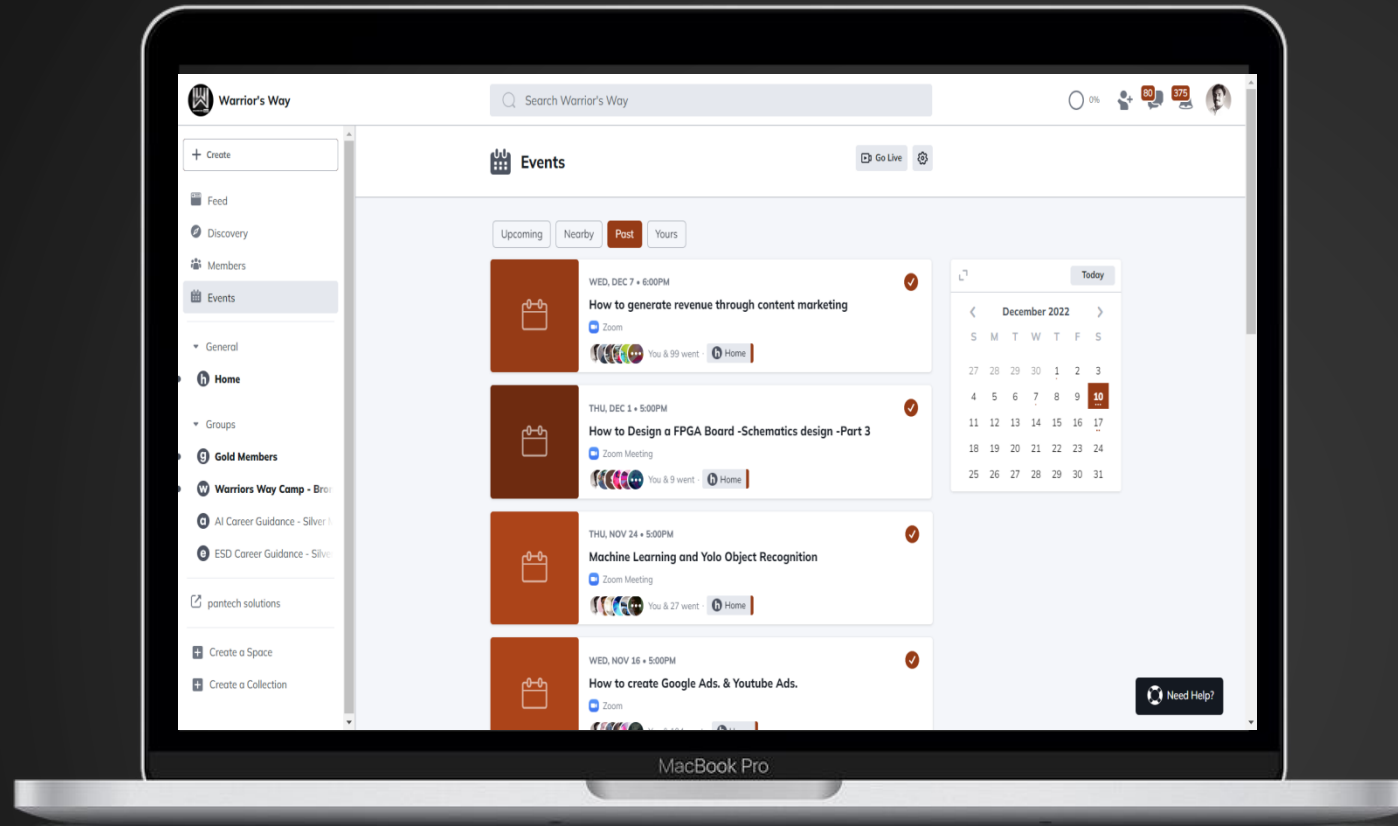
Private **Social Network** Access

ACTUAL VALUE

~~₹29482/ Yr~~

Rs 9999

(Inclusive of GST)



Connect with 1,000+ Active Members

LOCATION BASED TAGGING

PRIVATE NETWORK ACCESS



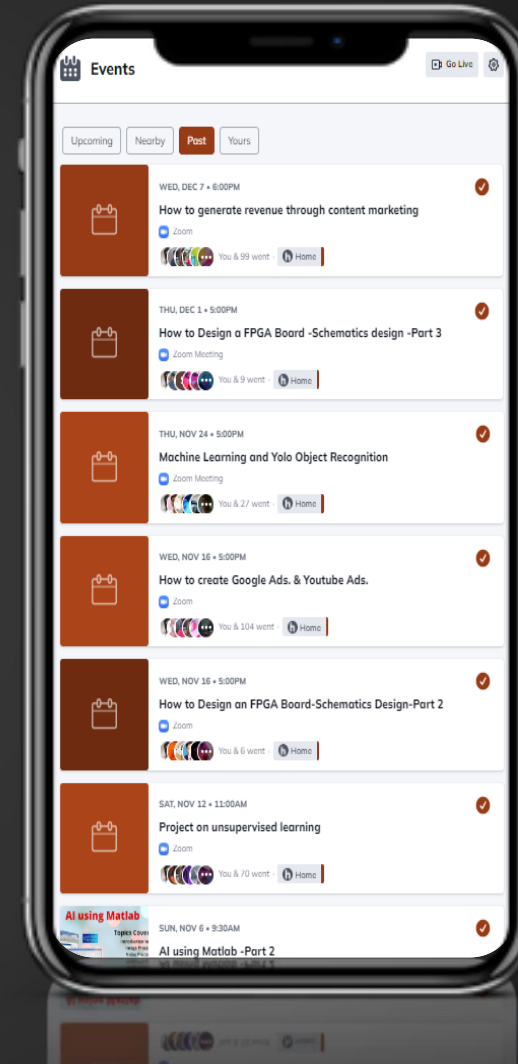
Weekly Master Mind

Weekend

FREE

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Attend Weekly Inner Circle Master Minds Mobile Phone !



Today Offer

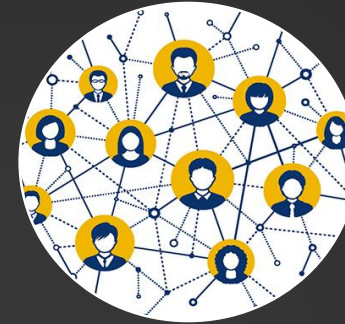


25 Courses

~~₹45,979, VALUE~~



~~₹9,999~~



Network & Coaching

~~₹7,998 VALUE~~

₹4,999 ONLY

Activity & Assignment DISCORD

□ Time for ATTENDANCE □

2 Minutes

Fill up the Attendance, Link given in live chat

**You are the Product of
your own thoughts
“Strangest Secret-
Earl Nightingale”**

THANK YOU