2b) Changes to Pentium compared to its predecessors

1) Cache:

The predecessors like 8086 used a single 8KB cache that was shared b/w data and instructions. This could lead to data intense programs running out of cache for instructions.

This is solved by having two 8KB caches one for data and one for instructions. ~~Also, has 64 bits data bus, which allows it to read a quadword in one cycle.~~

2) Memory

Has 4MB of memory similar to predecessors. The memory is divided into 8 banks which can be selected using Bank Enable signals.

Unlike 8086, the parity check is built in. also, Address is also checked for parity when $\overline{\text{APCHK}}$ is logic 0, the addresses are not valid and the execution is stopped.

~~3) Timing~~

3) Branch prediction:

Pentium implements branch prefetching using branch prediction.

This allows the execution of the branch instruction in one clock cycle if the prediction is correct (most of the time) or three clock cycles if it errs.

4) Superscalar architecture.

Pentium has three execution units

1) A coprocessor to execute floating point instructions
   eg: FADD ST, ST(2)
2) A U-pipe execution unit to execute integer instructions (primary)
3) A V-pipe execution unit to execute integer instructions (slower)

~~eg~~

This means 3 instruction when independent can be simultaneously executed

eg: FADD ST, ST(2), MOV AX, 5 MOV BX, 6
    coprocessor U pipe V pipe

5) A 64 bit data bus

This allows the processor to read either a ~~bit~~ byte (8 bits)
word (16 bits)
double word (32 bits) or a
quad word (64 bits)
based on the Bank Enables chosen.
This contributes a faster throughput and also allows longer floating point numbers and instructions.

2b ii)

Feature	i3	i5	i7
Cores	2-4	4-6	6-8
Threads	4-8	8-12	12-16
Cache	32MB L3	64 MB L3	256 MB L3
Overclocking	Not available	in K series chips	in K series chips
Turbo boost	No	Yes	Yes
Hyperthreading	No	Yes	Yes
Power consumption	35W-65W TDP	65-95W TDP	65-125 W TDP

Features of intel i3, i5, i7 chips

i3:
used for low power intensive work loads like web browsing and office usage.

i5:
used for higher intensive work like professional software

i7:
for high end gaming and scientific computing.

Overclocking:
Increasing the clock speed over the base frequency, this directly increases the throughput, usually done manually.

Turbo Boost:
This is a feature which automatically increases the clock frequency over the base level, based on the amount of work load.

2c ii)

Hyper threading:

Divides a physical core into two logical threads, hence parallelising it and improving the throughput.

This takes advantage of parallelisation and pipelining

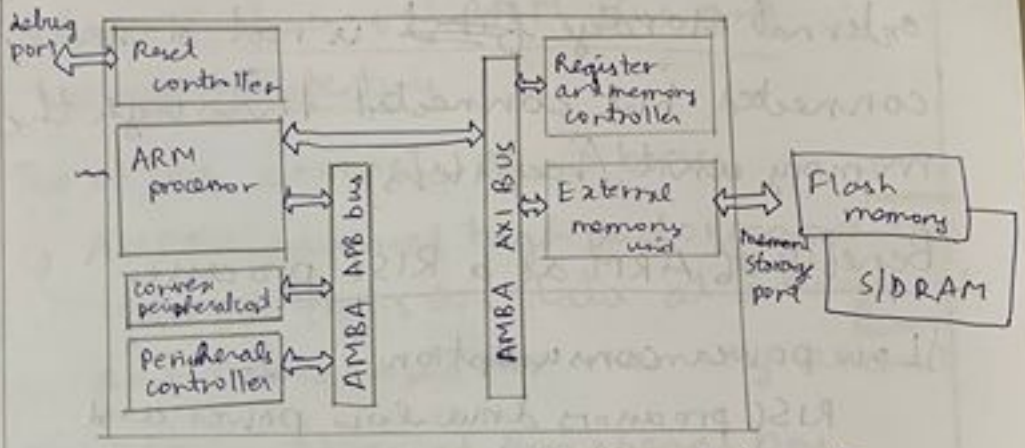
Power consumption:

Interms of power consumption and heat produced

i3 < i5 < i7

2c ii) ARM processor

Hardware architecture Diagram



The ARM processors are fabricated into SoCs (System on Chip) and hence a fully packed, non repairable unit which has only 2 ports, one for debugging and one for external storage

There are two main buses used The faster AXI bus (advanced extendible interface) is used for data transfer with memory.

The slower APB (Advanced peripheral bus) is used to interface with peripherals.

As all instructions are load/store, external storage ~~first~~ is not directly connected but connected through the memory unit. (registers)

Benefits of ARM as a RISC processor

1) Low power consumption:
   RISC processors draw low power and use simpler instructions
2) Simpler instructions:
   Instructions are simple
3) Verbose and more control to the ~~dave~~ software engineers
4) Instructions are orthogonal
5) Instructions are executed in a single cycle.
6) Useful in always on, less intensive machines like embedded ~~mach~~ electronics in cameras etc.

And in mobile devices which greatly improve battery life compared to CISC processors.

Salient features of ARM Bus and Memory Architecture

The AMBA consists of 3 buses

1) AHPB - advanced high performance bus
   This bus transfers data at a high rate and hence used for memory access.
2) APB - Advanced Peripheral bus
   Used for interfacing with peripheral devices.
3) AXI - Advanced Extendible Interface.
   This is a fast interface used for data transfer and memory access.