Ape

DONTRELEASEME-133

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Contents

Chapter 1

Main Page

Welcome

Ape (Another PC Emulator) is an experimental IBM PC compatible emulator written in C++17.

Important pages

- Terms.dox - Should help newcomers with understanding the terminology used in this documentation

Classes worth reading up on

Machine Core::Machine Core::HW::FloppyDrive CPU Core::CPU::CPU Core::CPU::Instruction

Chapter 2

Hierarchical Index

2.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Chapter 3

Class Index

3.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 4

File Index

4.1 File List

Here is a list of all documented files with brief descriptions:

Chapter 5

Class Documentation

5.1 Core::CPU::CPU Class Reference

Representation of the Central Processing Unit.

`#include <CPU.h>`

Public Member Functions

- **CPU** (Machine *machine)
- void Tick ()

  Execute one CPU cycle.
- void Start ()

  Execute instructions until shutdown is requested.

Public Attributes

- u16 & AX = AX_struct.AX

  AX (Accumulator)
- u8 & AH = AX_struct.b8.AH

  AH (High)
- u8 & AL = AX_struct.b8.AL

  AL (Low)
- u16 & BX = BX_struct.BX

  BX.
- u8 & BH = BX_struct.b8.BH

  BH (High)
- u8 & BL = BX_struct.b8.BL

  BL (Low)
- u16 & CX = CX_struct.CX

  CX.
- u8 & CH = CX_struct.b8.CH

  CH (High)
- u8 & CL = CX_struct.b8.CL

CL (Low)

- u16 & DX = DX_struct.DX

  DX.

- u8 & DH = DX_struct.b8.DH

  DH (High)

- u8 & DL = DX_struct.b8.DL

  DL (Low)

- u16 CS = 0

  Code Segment.

- u16 DS = 0

  Data Segment.

- u16 ES = 0

  Extra(?) Segment.

- u16 SS = 0

  Stack Segment.

- u16 IP = 0

  Instruction Pointer.

- u16 BP = 0

  Base Pointer.

- u16 SP = 0

  Stack Pointer.

- u16 SI = 0

  Source Index.

- u16 DI = 0

  Destination Index.

- bool AF = false

  Adjust Flag.

- bool CF = false

  Carry Flag.

- bool IF = true

  Interrupt Flag.

- bool DF = false

  Direction Flag.

- bool OF = false

  Overflow Flag.

- bool PF = false

  Parity Flag.

- bool SF = false

  Sign Flag.

- bool ZF = false

  Zero Flag.

- bool simulate_msdos = false

  Simulate MS-DOS (Handle its interrupts)

- std::atomic< bool > running = false

  Set whether the CPU is running.

5.1.1 Detailed Description

Representation of the Central Processing Unit.

The documentation for this class was generated from the following files:

- /home/max/sources/ape/Source/Core/CPU/CPU.h
- /home/max/sources/ape/Source/Core/BIOS/Interrupt.cpp
- /home/max/sources/ape/Source/Core/CPU/CPU.cpp
- /home/max/sources/ape/Source/Core/CPU/Flags.cpp
- /home/max/sources/ape/Source/Core/CPU/Flags.h

5.2 Core::HW::FloppyDrive Class Reference

Representation of a floppy drive.

`#include <FloppyDrive.h>`

Public Member Functions

- bool Insert (const std::string &path)
  Insert an image into the drive.
- bool HasDisc () const
  Check if a disc is present.
- u32 GetSize () const
  Get the size of the inserted disc.
- bool IsBootable ()
  Check if the provided image is bootable.
- u32 GetSectorSize () const
  Get size of a floppy.
- u32 GetSectorsPerTrack () const
  Get sectors per track.
- u32 GetHeadCount () const
  Get head count.
- void Eject ()
  Eject the image.
- bool Read (u32 offset, u32 size, u8 *buffer)
  Read data from the image.
- bool **Read** (u8 cylinder, u8 head, u8 sector, u8 count, u8 *buffer)

5.2.1 Detailed Description

Representation of a floppy drive.

The documentation for this class was generated from the following files:

- /home/max/sources/ape/Source/Core/HW/FloppyDrive.h
- /home/max/sources/ape/Source/Core/HW/FloppyDrive.cpp

5.3 Core::CPU::Instruction Class Reference

High-Level representation of a instruction.

`#include <Instruction.h>`

Classes

- class Parameter

  High-Level representation of a instruction parameter.

Public Types

- enum SegmentPrefix : u8

  Enum of all possible segment prefixes.
- enum Type : u8 { **PRIVATE** }

  Determines the type of the instruction.

Public Member Functions

- Instruction (u8 opcode, u32 offset=0)

  Turns the provided opcode into an Instruction.
- Instruction (const Instruction &ins, u8 opcode, u32 offset=0)

  One but with prefixes.
- Type GetType () const

  Get the Type associated with this instruction.
- SegmentPrefix GetPrefix () const

  Get the SegmentPrefix associated with this instruction.
- bool IsResolved ()

  Checks whether this Instruction needs further resolving.
- bool IsPrefix () const

  Checks if this instruction is actually a prefix.
- bool Resolve (u8 mod, std::vector< u8 > data)

  Resolves the Instruction.
- u8 GetLength (u8 mod)

  Get the length of the instruction provided.
- std::string ToString () const

  Get a disassembly for the Instruction provided.
- const std::vector< Parameter > & GetParameters () const

  Get a vector of parameters.
- Parameter & GetParameter (size_t index)

  Get a specific vector.
- void AddParameter (Parameter parameter)

  Add a new parameter.

5.3.1 Detailed Description

High-Level representation of a instruction.

5.3.2 Member Enumeration Documentation

5.3.2.1 SegmentPrefix

```
enum Core::CPU::Instruction::SegmentPrefix :  u8  [strong]
```

Enum of all possible segment prefixes.

These prefixes override the default segment of an instruction.

5.3.3 Constructor & Destructor Documentation

5.3.3.1 Instruction()

```
Core::CPU::Instruction::Instruction (
            u8 opcode,
            u32 offset = 0 )  [explicit]
```

Turns the provided opcode into an Instruction.

Parameters

opcode	Opcode to be decoded

5.3.4 Member Function Documentation

5.3.4.1 GetLength()

```
u8 Instruction::GetLength (
            u8 mod )
```

Get the length of the instruction provided.

Returns

Length of the instruction in bytes

5.3.4.2 Resolve()

```
bool Instruction::Resolve (
            u8 mod,
            std::vector< u8 > data )
```

Resolves the Instruction.

Parameters

mod	Modifier byte. The byte after the opcode regardless if it is used as such
data	needs to have as many bytes as specified in GetInstructionLength()

Returns

Returns `false` if there was an error during resolving.

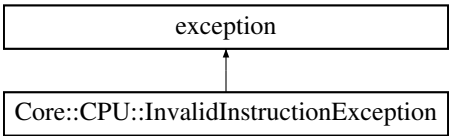
The documentation for this class was generated from the following files:

- /home/max/sources/ape/Source/Core/CPU/Instruction.h
- /home/max/sources/ape/Source/Core/CPU/Decoder.cpp
- /home/max/sources/ape/Source/Core/CPU/Instruction.cpp

5.4 Core::CPU::InvalidInstructionException Class Reference

`#include <Exception.h>`

Inheritance diagram for Core::CPU::InvalidInstructionException:



5.4.1 Detailed Description

Thrown when the CPU hits an instruction that couldn't be resolved / is invalid

The documentation for this class was generated from the following file:

- /home/max/sources/ape/Source/Core/CPU/Exception.h

5.5 Core::Machine Class Reference

Representation of a PC.

`#include <Machine.h>`

Public Member Functions

- HW::FloppyDrive & GetFloppyDrive ()

  Get this machines HW::FloppyDrive.
- Memory & GetMemory ()

  Get this machines Memory.
- bool BootFloppy ()

  Boot the machine from the floppy drive.
- void Shutdown ()

  Shutdown the machine.
- bool BootCOM (const std::string &file)

  Directly execute a COM file.

5.5.1 Detailed Description

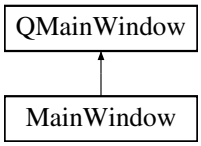
Representation of a PC.

The documentation for this class was generated from the following files:

- /home/max/sources/ape/Source/Core/Machine.h
- /home/max/sources/ape/Source/Core/Machine.cpp

5.6 MainWindow Class Reference

Inheritance diagram for MainWindow:



The documentation for this class was generated from the following files:

- /home/max/sources/ape/Source/ApeQt/MainWindow.h
- /home/max/sources/ape/Source/ApeQt/MainWindow.cpp

5.7 Core::Memory Class Reference

Wrapper around emulated RAM.

```
#include <Memory.h>
```

Public Member Functions

- Memory (u32 size)
  Create Memory of the specified size (in bytes)
- std::vector< u8 > & Get ()
  Get the contents of RAM.
- template<typename T >
  T & **Get** (u16 segment, u16 offset)
- template<typename T >
  T * **GetPtr** (u16 segment, u16 offset)

Static Public Member Functions

- static u32 VirtToPhys (u16 segment, u16 offset)
  Converts a virtual address to an absolute one.

5.7.1 Detailed Description

Wrapper around emulated RAM.

The documentation for this class was generated from the following files:

- /home/max/sources/ape/Source/Core/Memory.h
- /home/max/sources/ape/Source/Core/Memory.cpp

5.8 Core::CPU::Instruction::Parameter Class Reference

High-Level representation of a instruction parameter.

`#include <Instruction.h>`

Public Types

- enum Type : u8 { **PRIVATE** }
  Enum to determine the types of parameters.

Public Member Functions

- Parameter (Parameter::Type type)
  Create a parameter with the Instruction::Parameter::Type provided.
- void Resolve (u32 data)
  Provide the parameter with its missing data.
- void Resolve (Parameter::Type type, u32 data=0)
  Change the type of the parameter and provide missing data (if any)
- Type GetType () const
  Get the parameters type.
- template<typename T >
  T GetData () const
  Get the data associated with this parameter.
- bool IsResolved () const
  Returns `true` if this parameter is resolved.
- bool IsWord () const
  Returns `true` if this parameter points to or is a word.
- std::string ToString (SegmentPrefix prefix=SegmentPrefix::None, u32 offset=0) const
  Get a human readable form of this parameter.

5.8.1 Detailed Description

High-Level representation of a instruction parameter.

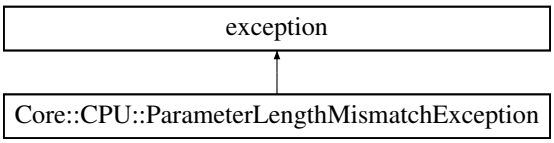
The documentation for this class was generated from the following files:

- /home/max/sources/ape/Source/Core/CPU/Instruction.h
- /home/max/sources/ape/Source/Core/CPU/Instruction.cpp

5.9 Core::CPU::ParameterLengthMismatchException Class Reference

`#include <Exception.h>`

Inheritance diagram for Core::CPU::ParameterLengthMismatchException:



5.9.1 Detailed Description

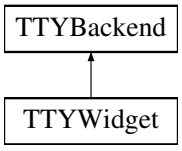
Thrown when a `word` and `byte` parameter are used together when they shouldn't be

The documentation for this class was generated from the following file:

- /home/max/sources/ape/Source/Core/CPU/Exception.h

5.10 TTYBackend Class Reference

Inheritance diagram for TTYBackend:



Public Member Functions

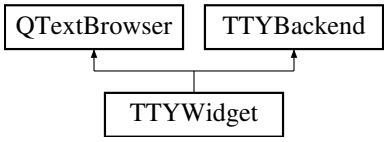
- virtual void **Write** (const std::string &string)=0
- virtual void **Write** (const char c)=0
- virtual void **Scroll** (const u8 lines, const u8 colors)=0
- virtual void **MoveCursor** (const u32, const u32)=0
- virtual u8 **GetCursorRow** () const =0
- virtual void **SetCursorRow** (u8 row)=0
- virtual u8 **GetCursorColumn** () const =0
- virtual void **SetCursorColumn** (u8 column)=0
- virtual void **Clear** ()=0
- virtual char **Read** ()=0

The documentation for this class was generated from the following file:

- /home/max/sources/ape/Source/Core/TTYBackend.h

5.11 TTYWidget Class Reference

Inheritance diagram for TTYWidget:



Public Member Functions

- void **Write** (const std::string &string) override
- void **Write** (const char c) override
- void **Scroll** (const u8 lines, const u8 colors) override
- void **MoveCursor** (const u32 x, const u32 y) override
- u8 **GetCursorRow** () const override
- void **SetCursorRow** (u8 row) override
- u8 **GetCursorColumn** () const override
- void **SetCursorColumn** (u8 column) override
- void **Clear** () override
- char **Read** () override

Public Attributes

- u8 **m_row** = 0
- u8 **m_column** = 0

The documentation for this class was generated from the following files:

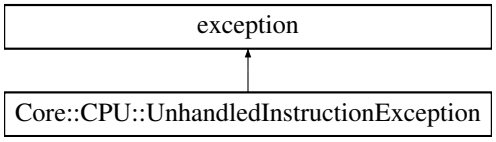
- /home/max/sources/ape/Source/ApeQt/TTYWidget.h
- /home/max/sources/ape/Source/ApeQt/TTYWidget.cpp

5.12 Core::CPU::UnhandledInstructionException Class Reference

Thrown when the CPU hits an unimplemented Instruction::Type.

`#include <Exception.h>`

Inheritance diagram for Core::CPU::UnhandledInstructionException:



5.12.1 Detailed Description

Thrown when the CPU hits an unimplemented Instruction::Type.

The documentation for this class was generated from the following file:

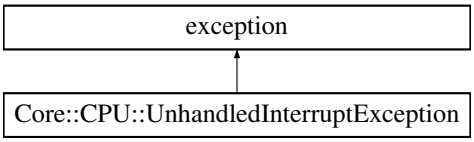
- /home/max/sources/ape/Source/Core/CPU/Exception.h

5.13 Core::CPU::UnhandledInterruptException Class Reference

Thrown when a interrupt is neither handled by software nor hardware.

`#include <Exception.h>`

Inheritance diagram for Core::CPU::UnhandledInterruptException:



5.13.1 Detailed Description

Thrown when a interrupt is neither handled by software nor hardware.

The documentation for this class was generated from the following file:

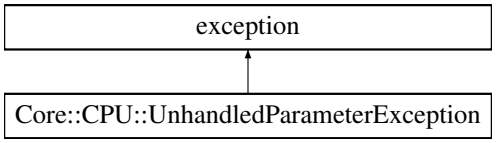
- /home/max/sources/ape/Source/Core/CPU/Exception.h

5.14 Core::CPU::UnhandledParameterException Class Reference

Thrown when the CPU hits an unimplemented Instruction::Parameter::Type.

`#include <Exception.h>`

Inheritance diagram for Core::CPU::UnhandledParameterException:



5.14.1 Detailed Description

Thrown when the CPU hits an unimplemented Instruction::Parameter::Type.

The documentation for this class was generated from the following file:

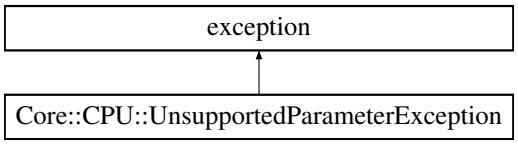
- /home/max/sources/ape/Source/Core/CPU/Exception.h

5.15 Core::CPU::UnsupportedParameterException Class Reference

Thrown when a instruction doesn't support the parameter type provided.

`#include <Exception.h>`

Inheritance diagram for Core::CPU::UnsupportedParameterException:



5.15.1 Detailed Description

Thrown when a instruction doesn't support the parameter type provided.

The documentation for this class was generated from the following file:

- /home/max/sources/ape/Source/Core/CPU/Exception.h

Chapter 6

File Documentation

6.1 /home/max/sources/ape/Docs/Terms.dox File Reference

6.1.1 Detailed Description

Terminology

Here are some common terms used in this documentation and their meaning

PC

Personal Computer. Means IBM PC in this context,

Also commonly used as a synonym for IP.

RAM

Random Access Memory. Means non-sequential, volatile memory in this context.

CPU

Centeral Processing Unit. Most important component of a PC that controls all other components.

Opcode

Operation code. A byte (or byte + register modifier) that tells the CPU what type of instruction to execute.

Instruction

The smallest kind of "command" the CPU processes. Usually only performs one simple task and updates flags accordingly.

Instructions are usually represented as:

```
OPERATION destination, source
```

Although there are some slight deviations (operations without parameters / a source).

Flags

Indicators of the results of previous instructions. Often used in conjungtion with conditional jumps.

AF

Adjust Flag. Used when adjusting values (e.g. DAA)

CF

Carry Flag. Used when an arithmetic instruction exceeds the lower bounds of the data type.

OF

Overflow Flag. Used when an instruction exceeds the upper bounds of the data type.

PF

Parity Flag. Indicates whether the result of an instruction has bit-parity (The same amount of ones and zeros).

SF

Sign Flag. Indicates whether the signed result of an instruction is negative. (If set, negative else posiive).

ZF

Zero Flag. Indicates whether the result of an instruction is zero.

IF

Interrupt Flag. Enables / Disables interrupts.

DF

Direction Flag. Used by string instructions to decide whether to increment or decrement after an operation (If set, decrement else increment).

Registers

Registers can be thought of as very fast memory (much faster than RAM) inside a CPU that operations can be performed on.

In many cases data in memory is not changed in place but instead loaded into registers modified and then stored back to memory.

General purpose

Registers that can be freely modified by the programmer.

AX/AH/AL

Often used as an accumulator.

BX/BH/BL

Often used to point at data in the data segment.

CX/CH/CL

Often used as a counter (e.g. by REP).

DX/DH/DL

Often used as an I/O pointer.

Segment registers

Segment registers control which part (segment) of memory is used by the CPU for certain tasks.

CS

Code Segment. Used in conjungtion with IP for fetching opcodes

DS

Data Segment. Used by default in most instructions dealing with loading values from memory.

ES

Extra Segment. Used as a destination segment in string instructions

SS

Stack Segment. Used for storing the stack segment.

Pointers

IP

Instruction Pointer. Used in conjungtion with CS to represent the current offset.

BP

Base Pointer. Pointer to data on the stack

SP

Stack Pointer. Pointer to the current top of stack

SI

Source Index. Used as a source pointer by string instructions.

DI

Destination Index. Used as a destination pointer by string instructions.

6.2 /home/max/sources/ape/Source/Common/Logger.h File Reference

```
#include <string>
```

Macros

- #define LOG(msg) __MSG("LOG", __FILE__, __LINE__, msg)

  Log a message.
- #define WARN(msg) __MSG("WARNING", __FILE__, __LINE__, msg)

  Log a warning.
- #define ERROR(msg) __MSG("ERROR", __FILE__, __LINE__, msg)

  Log an error.

6.3 /home/max/sources/ape/Source/Common/Types.h File Reference

```
#include <cstdint>
```

Typedefs

- using u8 = uint8_t

  A 8-bit unsigned integer (unsigned byte)
- using i8 = int8_t

  A 8-bit signed integer (unsigned byte)
- using u16 = uint16_t

  A 16-bit unsigned integer (unsigned word)
- using i16 = int16_t

  A 16-bit signed integer (unsigned word)
- using u32 = uint32_t

  A 32-bit unsigned integer.
- using i32 = int32_t

  A 32-bit signed integer.
- using u64 = uint64_t

  A 64-bit unsigned integer.
- using i64 = int64_t

  A 64-bit signed integer.

6.4 /home/max/sources/ape/Source/Core/CPU/CPU.h File Reference

```
#include <atomic>
#include "Common/Types.h"
#include "Core/CPU/Instruction.h"
#include "Core/Memory.h"
```

Classes

- class Core::CPU::CPU

  Representation of the Central Processing Unit.

6.5 /home/max/sources/ape/Source/Core/CPU/Exception.h File Reference

```
#include <exception>
```

Classes

- class Core::CPU::InvalidInstructionException
- class Core::CPU::UnhandledInstructionException

  Thrown when the CPU hits an unimplemented Instruction::Type.
- class Core::CPU::UnhandledParameterException

  Thrown when the CPU hits an unimplemented Instruction::Parameter::Type.
- class Core::CPU::ParameterLengthMismatchException
- class Core::CPU::UnsupportedParameterException

  Thrown when a instruction doesn't support the parameter type provided.
- class Core::CPU::UnhandledInterruptException

  Thrown when a interrupt is neither handled by software nor hardware.

6.6 /home/max/sources/ape/Source/Core/CPU/Instruction.h File Reference

```
#include <map>
#include <string>
#include <vector>
#include "Common/Types.h"
```

Classes

- class Core::CPU::Instruction

  High-Level representation of a instruction.
- class Core::CPU::Instruction::Parameter

  High-Level representation of a instruction parameter.

Functions

- std::string Core::CPU::TypeToString (const Instruction::Type &type)

  Get the corresponding nmoroic for the Type provided.
- std::string Core::CPU::ParameterTypeToString (const Instruction::Parameter::Type &type, Instruction::↩ SegmentPrefix prefix=Instruction::SegmentPrefix::None)

  Get a human readable form of the Parameter::Type provided.
- bool Core::CPU::ParameterNeedsResolving (const Instruction::Parameter::Type &parameter)

  Checks whether this Parameter::Type needs resolving.

6.7 /home/max/sources/ape/Source/Core/HW/FloppyDrive.h File Reference

```
#include <fstream>
#include <memory>
#include <string>
#include <vector>
#include "Common/Types.h"
```

Classes

- class Core::HW::FloppyDrive

  Representation of a floppy drive.

6.8 /home/max/sources/ape/Source/Core/Machine.h File Reference

```
#include "Core/CPU/CPU.h"
#include "Core/HW/FloppyDrive.h"
#include "Core/Memory.h"
#include <vector>
```

Classes

- class Core::Machine

  Representation of a PC.

6.9 /home/max/sources/ape/Source/Core/Memory.h File Reference

```
#include <vector>
#include "Common/Types.h"
```

Classes

- class Core::Memory

  Wrapper around emulated RAM.

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