OneUp Wi-11 Simulator

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Contents

Chapter 1

Main Page

1.1 Introduction

The "Wi-11 Machine" is a simple, 16-bit computer architecture. It has 8 general purpose registers, 3 condition code registers (CCRs), and a program counter (PC). This software package is meant to emulate its execution, as well as present the user with information regarding the state of the machine after each instruction is executed. However, before one can delve into the behind-the-scenes details, one must understand the environment. In particular, an understanding of the object file syntax and the interactions between the components used in this project is necessary.

1.2 Object Files

The object files (ususally file_name.o) that this simulator accepts are ascii text files with the following structure:

- One Header Record
- Several Text Records
- One End Record

1.2.1 The Header Record

The Header Record is a single line that prepares the system for the storing the instructions to come.

Components

- A capital 'H'. This designates that it is the Header Record.
- A 6 character "segment name" (anything will do).
- A 4-digit Hexadecimal value that corresponds to the "load address" of the program. Instructions can be written starting at this address.
- A second 4-digit Hexadecimal value that denotes the length of the program-load segment (the size of memory into which the instructions will be loaded).

At a glance: There is an 'H', a segment name, the first location where instructions can be written, and the number of memory locations for instuctions.

1.2.2 Text Records

Following the Header Record are serveral Text Records. Each Text Record corresponds to a single machine instruction and, like the header record, is on a single line.

Components

- A capital 'T'. This designates that it is a Text Record.
- A 4-digit hexadecimal value -- The location in memory at which the instruction will be stored.
- A second 4-digit Hexadecimal value -- The encoding of the instruction to be stored.

At a glance: There is a 'T', the location to store the instruction, and the instruction itself.

1.2.3 The End Record

The End Record is, as the name would suggest, the last line of the line. Its purpose is to denote the end of instructions to be written and to give an initial value for the PC.

Components

- The End Record begins with a capital 'E'.
- Next, and last, a 4-digit hexadecimal value to be put into the PC.

At a glance: There is an ’E’, and the location in memory from which the first instruction should be fetched.

1.3 Interactions

1.3.1 Components

1.3.2 Wi11 Instruction Set

Chapter 2

Directory Hierarchy

2.1 Directories

This directory hierarchy is sorted roughly, but not completely, alphabetically:

Chapter 3

Class Index

3.1 Class Hierarchy

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

Chapter 4

Class Index

4.1 Class List

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

Chapter 5

File Index

5.1 File List

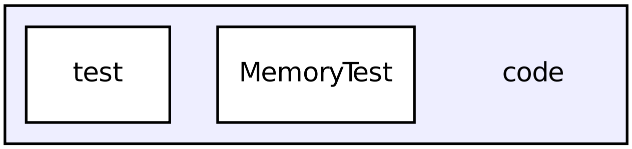
Here is a list of all documented files with brief descriptions:

Chapter 6

Directory Documentation

6.1 code/ Directory Reference

Directory dependency graph for code/:



Directories

- directory MemoryTest
- directory test

Files

- file **iDecoder.h**
- file **iInterpreter.h**

- file **iLoader.h**
- file **iMemory.h**
- file **iObjParser.h**
- file iRegister.h

  Definition of a "register" in the Wi-11 machine.

- file **iSimulator.h**
- file iWi11.h

  Definition of the Wi-11 machine simulator.

- file **iWord.h**
- file **Main.cpp**
- file **Memory.cpp**
- file **Memory.h**
- file **Register.cpp**
- file Register.h

  Definition of private data for the "Register" class.

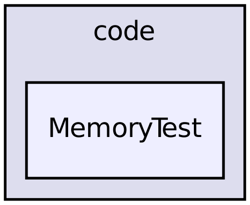
- file **ResultCodes.h**
- file Wi11.h

  Definition of the private data for the "Wi11" class.

- file **Word.cpp**
- file **Word.h**

6.2 code/MemoryTest/ Directory Reference

Directory dependency graph for code/MemoryTest/:

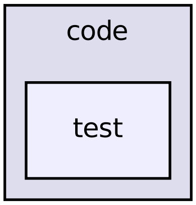


Files

- file **MemoryTest/iMemory.h**
- file **MemoryTest/iWord.h**
- file **MemoryTest/Memory.cpp**
- file **MemoryTest/Memory.h**
- file **MemoryTest.cpp**
- file **MemoryTest/ResultCodes.h**
- file **MemoryTest/Word.cpp**
- file **MemoryTest/Word.h**

6.3 code/test/ Directory Reference

Directory dependency graph for code/test/:



Files

- file **RegisterTest.cpp**
- file **WordTest.cpp**

Chapter 7

Class Documentation

7.1 iDecoder Class Reference

Public Member Functions

- virtual Instruction **DecodeInstruction** (const iWord &) const =0

7.2 iInterpreter Class Reference

7.3 iLoader Class Reference

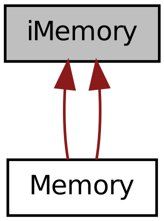
Public Member Functions

- virtual **iLoader** (iMemory ∗)=0
- virtual Codes::RESULT **Load** (const char ∗filename, iWord &PC_address)=0

7.4 iMemory Class Reference

Mimics the functionality of memory in the Wi-11 machine.

Inheritance diagram for iMemory:



Public Member Functions

- virtual Codes::RESULT Reserve (const iWord &initial_address, const iWord &length)=0

    Reserves an initial section of memory for instructions.

- virtual Word Load (const iWord &w) const =0

    Performs a load.

- virtual Codes::RESULT Store (const iWord &address, const Word &value)=0

    Peforms a store.

- virtual Codes::RESULT **Reserve** (const iWord &initial_address, const iWord &length)=0
- virtual Word **Load** (const iWord &) const =0
- virtual Codes::RESULT **Store** (const iWord &address, const Word &value)=0

7.4.1 Detailed Description

Mimics the functionality of memory in the Wi-11 machine. Its size is limited only by addressability (2^16-1 16-bit words). It is meant to be implemented in such a way that the memory initialized for instructions can be accessed in constant time while addresses outside this range are accessed in nlogn time.

7.4.2 Member Function Documentation

7.4.2.1 virtual Codes::RESULT iMemory::Reserve (const iWord & *initial_address,* const iWord & *length*) `[pure virtual]`

Reserves an initial section of memory for instructions.

Parameters

`in`	*initial_address*	The smallest address for the instruction memory.
`in`	*length*	The number of addresses to reserve.

Returns

> SUCCESS or, if something goes wrong, an appropriate error code.

The memory reserved here is dynamically allocated and provides constant-time access to addresses "initial_address" through "initial_address"+"length"-1.

Implemented in Memory, and Memory.

7.4.2.2 virtual Word iMemory::Load (const iWord & *w*) const `[pure virtual]`

Performs a load.

Parameters

`in`	*w*	The address from which to load data.

Returns

> The data stored a address "w".

Note

> If "w" is in the range created by Reserve(), it can be accessed in constant time. Otherwise, a maximum of nlogn time is required if n is the size of memory initialized outside of these boundaries.

Implemented in Memory, and Memory.

7.4.2.3 virtual Codes::RESULT iMemory::Store (const iWord & *address,* const Word & *value*) `[pure virtual]`

Peforms a store.

Parameters

in	*address*	The address to store the data.
in	*value*	The data to store at "address".

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

The efficiency constraints in Load() apply here as well.

Implemented in Memory, and Memory.

7.5 Instruction Struct Reference

Public Attributes

- INSTRUCTION_TYPE **type**
- std::vector< Word > **data**

7.6 iObjParser Class Reference

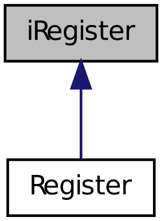
Public Member Functions

- virtual Codes::Result **Initialize** (const char ∗)=0
- virtual ObjectData **GetNext** ()=0

7.7 iRegister Class Reference

Defines a "register" in the Wi-11 machine.

Inheritance diagram for iRegister:



Public Member Functions

- virtual Word GetValue () const =0

  Retrieves a copy of the word of data store in the register.

- virtual void Add (const iWord &w)=0

  Adds a word of data to the calling object.

- virtual Register Add (const iRegister &r) const =0

  Adds a word of data to the calling object.

- virtual Register operator+ (const iRegister &r) const =0

  A standard add operator.

- virtual void Subtract (const iWord &w)=0

  Subtracts a word of data from the calling object.

- virtual Register Subtract (const iRegister &r) const =0

  Subtracts a word of data from the calling object.

- virtual Register operator- (const iRegister &r) const =0

  A standard subtraction operator.

- virtual void And (const iWord &w)=0

  Performs a bit-wise and.

- virtual Register And (const iRegister &r) const =0

  Performs a bit-wise and.

- virtual void Or (const iWord &w)=0

  Performs a bit-wise "or".

- virtual Register Or (const iRegister &r) const =0

  Performs a bit-wise or.

- virtual void Not ()=0

  Performs a bit-wise not.

- virtual Register Not () const =0

  Performs a bit-wise not.

- virtual void Store (const iWord &w)=0

  Stores a word of data.

- virtual void Store (const iRegister &r)=0

  Stores a copy of another register.

- virtual Register & operator= (const iWord &w)=0

  A standard assignment operator.

- virtual Register & operator= (const Register r)=0

  A standard assignment operator.

- virtual Register & operator++ ()=0

  A standard pre-increment operator.

- virtual Register & operator++ (int)=0

  A standard post-increment operator.

7.7.1 Detailed Description

Defines a "register" in the Wi-11 machine. The methods present in this inteface are meant to mimic the functionality of the Wi-11 machine, allowing for simplified execution of the instructions therein. This interace class will serve as a base from which the general purpose registers and program counter of the Wi-11 can be defined.

7.7.2 Member Function Documentation

7.7.2.1 virtual Word iRegister::GetValue ( ) const `[pure virtual]`

Retrieves a copy of the word of data store in the register.

Postcondition

The value of the calling object is not changed.

Returns

A new Word object holding the value that is stored in the register.

Implemented in Register.

7.7.2.2 virtual void iRegister::Add (const iWord & *w*) `[pure virtual]`

Adds a word of data to the calling object.

Parameters

in	*w*	The value to be added.

Postcondition

The calling object equals its previous value plus the value of "w"; "w", however, will remain unchanged.

Implemented in Register.

7.7.2.3 virtual Register iRegister::Add (const iRegister & *r*) const `[pure virtual]`

Adds a word of data to the calling object.

Parameters

in	*r*	The value to be added.

Postcondition

Both the calling object and "r" will not be changed.

Returns

A new Register object holding the value of the calling object plus the value in "r".

Implemented in Register.

7.7.2.4 virtual Register iRegister::operator+ (const iRegister & *r*) const [pure virtual]

A standard add operator.

Note

"result = p + r" is equivalent to "result = p.Add(r)".

Implemented in Register.

7.7.2.5 virtual void iRegister::Subtract (const iWord & *w*) [pure virtual]

Subtracts a word of data from the calling object.

Parameters

in	*w*	The value to be subtracted.

Postcondition

The calling object equals its previous value minus the value of "w"; "w", however, will remain unchanged.

Implemented in Register.

7.7.2.6 virtual Register iRegister::Subtract (const iRegister & *r*) const [pure virtual]

Subtracts a word of data from the calling object.

Parameters

in	*r*	The value to be subtracted.

Postcondition

Both the calling object and "r" will not be changed.

Returns

A new Register object holding the value of the calling object minus the value in "r".

Implemented in Register.

7.7.2.7 virtual Register iRegister::operator- (const iRegister & *r*) const [pure virtual]

A standard subtraction operator.

Note

"result = p - r" is equivalent to "result = r.Subtract(w)".

Implemented in Register.

7.7.2.8 virtual void iRegister::And (const iWord & *w*) [pure virtual]

Performs a bit-wise and.

Parameters

in	*w*	The value to be "and"ed.

Postcondition

The calling object equals its previous value bit-wise and'ed with w.

Implemented in Register.

7.7.2.9 virtual Register iRegister::And (const iRegister & *r*) const [pure virtual]

Performs a bit-wise and.

Parameters

in	*r*	The value to be "and"ed.

Postcondition

Both the calling object and r are not changed.

Returns

A new Register object holding the value of the calling object bit-wise and'ed with r.

Implemented in Register.

7.7.2.10 virtual void iRegister::Or (const iWord & *w*) [pure virtual]

Performs a bit-wise "or".

Parameters

in	*w*	The value to be "or"ed.

Postcondition

The calling object equals its previous value bit-wise or'ed with w.

Implemented in Register.

7.7.2.11 virtual Register iRegister::Or (const iRegister & *r*) const `[pure virtual]`

Performs a bit-wise or.

Parameters

in	*r*	The value to be "or"ed.

Postcondition

Both the calling object and r are not changed.

Returns

A new Register object holding the value of the calling object bit-wise or'ed with r.

Implemented in Register.

7.7.2.12 virtual void iRegister::Not ( ) `[pure virtual]`

Performs a bit-wise not.

Postcondition

The calling object's bits are all flipped (e.g. 1001 -> 0110).

Implemented in Register.

7.7.2.13 virtual Register iRegister::Not ( ) const `[pure virtual]`

Performs a bit-wise not.

Postcondition

The calling object is not changed.

Returns

A new Register object holding the bit-wise not of the calling object.

Implemented in Register.

7.7.2.14 virtual void iRegister::Store (const iWord & *w*) `[pure virtual]`

Stores a word of data.

Parameters

`in`	*w*	The value to be store.

Postcondition

The calling object's value is now "w".

Implemented in Register.

7.7.2.15 virtual void iRegister::Store (const iRegister & *r*) `[pure virtual]`

Stores a copy of another register.

Parameters

`in`	*r*	The register to be copied.

Postcondition

The calling object's value is now "r".

Implemented in Register.

7.7.2.16 virtual Register& iRegister::operator= (const iWord & *w*) `[pure virtual]`

A standard assignment operator.

Note

"r = w" is equivalent to "r.Store(w)"

Implemented in Register.

7.7.2.17 virtual Register& iRegister::operator= (const Register *r*) [pure virtual]

A standard assignment operator.

Note

"r1 = r2" is equivalent to "r1.Store(r2)"

Implemented in Register.

7.7.2.18 virtual Register& iRegister::operator++ ( ) [pure virtual]

A standard pre-increment operator.

Returns

A reference to itself.

The object increments its value BEFORE the execution of the current line.

Implemented in Register.

7.7.2.19 virtual Register& iRegister::operator++ (int) [pure virtual]

A standard post-increment operator.

Returns

A reference to itself.

The object increments its value AFTER the execution of the current line.

Implemented in Register.

7.8 iSimulator Class Reference

Public Member Functions

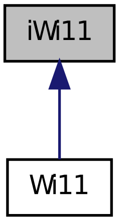
- virtual bool **Initialize** (const char ∗)=0
- virtual bool **Add** (const REGISTER_ID DR, const REGISTER_ID SR1, const REGISTER_ID SR2)=0
- virtual bool **Add** (const REGISTER_ID DR, const REGISTER_ID SR1, const iWord &immediate)=0

- virtual bool **And** (const REGISTER_ID DR, const REGISTER_ID SR1, const REGISTER_-ID SR2)=0
- virtual bool **And** (const REGISTER_ID DR, const REGISTER_ID SR1, const iWord &immediate)=0
- virtual bool **Branch** (const iWord &address)=0
- virtual bool **Debug** ()=0
- virtual bool **JSR** (const iWord &)=0
- virtual bool **JSRR** (const iWord &baseR, const iWord &address)=0
- virtual bool **Load** (const REGISTER_ID DR, const iWord &address)=0
- virtual bool **LDI** (const REGISTER_ID DR, const iWord &address)=0
- virtual bool **LDR** (const REGISTER_ID DR, const iWord &baseR, const iWord &address)=0
- virtual bool **Not** (const REGISTER_ID DR, const REGISTER_ID SR)=0
- virtual bool **Ret** ()=0
- virtual bool **Store** (const REGISTER_ID DR, const iWord &address)=0
- virtual bool **STI** (const REGISTER_ID DR, const iWord &address)=0
- virtual bool **STR** (const REGISTER_ID DR, const iWord &baseR, const iWord &address)=0
- virtual bool **Trap** (const iWord &address)=0

7.9 iWi11 Class Reference

Defines the internal logic of the Wi-11.

Inheritance diagram for iWi11:



Public Member Functions

- virtual iWi11 ()=0

  Creates and organizes the componts of the Wi11 machine.

- virtual bool LoadObj (const char ∗filename)=0

  Loads the object file and sets up memory as it describes.

- virtual void DisplayMemory () const =0

  Prints the state of memory to standard out.

- virtual void DisplayRegisters () const =0

  Prints the state of every register to standard out.

- virtual bool ExecuteNext (bool verbose=false)=0

  Executes the instruction pointed to by the PC.

Private Member Functions

- virtual iRegister & _GetRegister (const Decoder::REGISTER_ID &id)=0

  Retrieves a reference to the register corresponding to "id".

- virtual Codes::RESULT _Add (const Decoder::REGISTER_ID DR, const Decoder::REGISTER_ID SR1, const Decoder::REGISTER_ID SR2)=0

  Adds two registers and stores the result in a third.

- virtual Codes::RESULT _Add (const Decoder::REGISTER_ID DR, const Decoder::REGISTER_ID SR1, const iWord &immediate)=0

  Adds a constant to a register and stores the result in another.

- virtual Codes::RESULT _And (const Decoder::REGISTER_ID DR, const Decoder::REGISTER_ID SR1, const Decoder::REGISTER_ID SR2)=0

  Bit-wise ands two registers and stores the result in a third.

- virtual Codes::RESULT _And (const Decoder::REGISTER_ID DR, const Decoder::REGISTER_ID SR1, const iWord &immediate)=0

  Bit-wise ands a register with a constant and stores the result in another register.

- virtual Codes::RESULT _Branch (const iWord &address)=0

  Changes the last 9 bits of the PC.

- virtual Codes::RESULT _Debug ()=0

  Deprecated?

- virtual Codes::RESULT _JSR (const iWord &w)=0

  Initiate a jump to a subroutine (alter the PC).

- virtual Codes::RESULT _JSRR (const iWord &baseR, const iWord &address)=0

  Initiate a jump to a subroutine (alter the PC). param[in] baseR A register whose value acts as a base address.

- virtual Codes::RESULT _Load (const Decoder::REGISTER_ID DR, const iWord &address)=0

  Loads a word in memory into a register.

- virtual Codes::RESULT _LoadI (const Decoder::REGISTER_ID DR, const iWord &address)=0

  Performs an indirect load.

- virtual Codes::RESULT _LoadR (const Decoder::REGISTER_ID DR, Decoder::REGISTER_ID baseR, const iWord &address)=0

  Performs a register-relative load.

- virtual Codes::RESULT _Not (const Decoder::REGISTER_ID DR, const Decoder::REGISTER_ID SR)=0

  Bit-wise nots a register and stores the result in another.

- virtual Codes::RESULT _Ret ()=0

  Return from a subroutine.

- virtual Codes::RESULT _Store (const Decoder::REGISTER_ID SR1, const iWord &address)=0

  Stores a register's value into memory at a specified address.

- virtual Codes::RESULT _STI (const Decoder::REGISTER_ID SR1, const iWord &address)=0

  Performs an indirect store.

- virtual Codes::RESULT _STR (const Decoder::REGISTER_ID SR1, const Decoder::REGISTER_ID baseR, const iWord &address)=0

  Perfroms a register-relative store.

- virtual Codes::RESULT _Trap (const iWord &code)=0

  Branches to a trap vector.

7.9.1 Detailed Description

Defines the internal logic of the Wi-11.

> The methods present in this interface are meant to simulate the Wi-11's fetch-execute loop. Any implementation of this will be expected to house 8 private instances of the Register class as general purpose registers and each of these should have an associated REGISTER_ID enum token. A reference to an iMemory class is also necessary.

> The implementers of a super class will also have to incorporate some sort of interaction with a CCR structure. An interface for this interaction is not provided.

7.9.2 Constructor & Destructor Documentation

7.9.2.1 virtual iWi11::iWi11 ( ) `[pure virtual]`

Creates and organizes the componts of the Wi11 machine.

Initializes the general purpose registers, CCR, and memory.

7.9.3 Member Function Documentation

7.9.3.1 virtual iRegister& iWi11::_GetRegister (const Decoder::REGISTER_ID & *id*) `[private, pure virtual]`

Retrieves a reference to the register corresponding to "id".

Parameters

`in`	*id*	A REGISTER_ID corresponding to one of the private registers.

Returns

> A reference to the id'd register.

Implemented in Wi11.

7.9.3.2 virtual Codes::RESULT iWi11::_Add (const Decoder::REGISTER_ID *DR*, const Decoder::REGISTER_ID *SR1*, const Decoder::REGISTER_ID *SR2*) `[private, pure virtual]`

Adds two registers and stores the result in a third.

Parameters

out	*DR*	The destination register.
in	*SR1*	The first source register.
in	*SR2*	The second source register.

Postcondition

SR1 and SR2 are not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

Updates the CCR.

Implemented in Wi11.

7.9.3.3 virtual Codes::RESULT iWi11::_Add (const Decoder::REGISTER_ID *DR,* const Decoder::REGISTER_ID *SR1,* const iWord & *immediate*) [private, pure virtual]

Adds a constant to a register and stores the result in another.

Parameters

out	*DR*	The destination register.
in	*SR1*	The source register.
in	*immediate*	The immediate value.

Postcondition

SR1 and "immediate" are not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

Updates the CCR.

Implemented in Wi11.

7.9.3.4 virtual Codes::RESULT iWi11::_And (const Decoder::REGISTER_ID *DR*, const Decoder::REGISTER_ID *SR1*, const Decoder::REGISTER_ID *SR2*) `[private, pure virtual]`

Bit-wise ands two registers and stores the result in a third.

Parameters

`out`	*DR*	The destination register.
`in`	*SR1*	The first source register.
`in`	*SR2*	The second source register.

Postcondition

SR1 and SR2 are not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

Updates the CCR.

Implemented in Wi11.

7.9.3.5 virtual Codes::RESULT iWi11::_And (const Decoder::REGISTER_ID *DR*, const Decoder::REGISTER_ID *SR1*, const iWord & *immediate*) `[private, pure virtual]`

Bit-wise ands a register with a constant and stores the result in another register.

Parameters

`out`	*DR*	The destination register.
`in`	*SR1*	The source register.
`in`	*immediate*	The immediate value.

Postcondition

SR1 and "immediate" are not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

Updates the CCR.

Implemented in Wi11.

7.9.3.6 virtual Codes::RESULT iWi11::_Branch (const iWord & *address*) [private, pure virtual]

Changes the last 9 bits of the PC.

Parameters

in	*address*	The 9 bits to become the end of the PC.

Postcondition

"address" is not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Implemented in Wi11.

7.9.3.7 virtual Codes::RESULT iWi11::_Debug ( ) [private, pure virtual]

Deprecated?

Does nothing.

Implemented in Wi11.

7.9.3.8 virtual Codes::RESULT iWi11::_JSR (const iWord & *w*) [private, pure virtual]

Initiate a jump to a subroutine (alter the PC).

Parameters

in	*w*	A 9 bit offset for the PC.

Postcondition

The PC has "w" as its 9 least significant bits.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

> If the link bit was set for this instruction, R7 will hold the old value of the PC. However, the CCR will not be altered for this instruction, depite R7 being altered.

Implemented in Wi11.

7.9.3.9 virtual Codes::RESULT iWi11::_JSRR (const iWord & *baseR*, const iWord & *address*) [private, pure virtual]

Initiate a jump to a subroutine (alter the PC). param[in] baseR A register whose value acts as a base address.

Parameters

in	*address*	A 6 bit offset to the base address.

Postcondition

> The PC is the value in baseR plus the value in address.

Returns

> SUCCESS or, if something went wrong, an appropriate error code.

Note

> If the link bit was set for this instruction, R7 will hold the old value of the PC. However, the CCR will not be altered for this instruction, depite R7 being altered.

Implemented in Wi11.

7.9.3.10 virtual Codes::RESULT iWi11::_Load (const Decoder::REGISTER_ID *DR*, const iWord & *address*) [private, pure virtual]

Loads a word in memory into a register.

Parameters

out	*DR*	The destination register.
in	*address*	When concatenated with the PC, forms address in memory from which to load.

Postcondition

> Memory and "address" have not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

Updates the CCR.

Implemented in Wi11.

7.9.3.11 virtual Codes::RESULT iWi11::_LoadI (const Decoder::REGISTER_ID *DR*, const iWord & *address*) [private, pure virtual]

Performs an indirect load.

Parameters

out	*DR*	The destination register.
in	*address*	A 9-bit offset to the PC.

Postcondition

Memory and "address" have not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Works similar to _Load() but when memory is read, it uses the address found to again access memory. In this indirect way, a load can be made from anywhere in Memory.

Note

Updates the CCR.

Implemented in Wi11.

7.9.3.12 virtual Codes::RESULT iWi11::_LoadR (const Decoder::REGISTER_ID *DR*, Decoder::REGISTER_ID *baseR*, const iWord & *address*) [private, pure virtual]

Performs a register-relative load.

Parameters

out	*DR*	The destination register.
in	*baseR*	A register whose value works as a base address.
in	*address*	An 6-bit index from the base address.

Postcondition

Memory, "baseR", and "address" have no changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Loads from "baseR" plus "address".

Note

Updates the CCR.

Implemented in Wi11.

7.9.3.13 virtual Codes::RESULT iWi11::_Not (const Decoder::REGISTER_ID *DR*, const Decoder::REGISTER_ID *SR*) [private, pure virtual]

Bit-wise nots a register and stores the result in another.

Parameters

out	*DR*	The destination register.
in	*SR*	The source register.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

Updates the CCR.

Implemented in Wi11.

7.9.3.14 virtual Codes::RESULT iWi11::_Ret ( ) [private, pure virtual]

Return from a subroutine.

Postcondition

The PC now holds the value that was (and still is) in R7.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

This can be used to jump anywhere in memory. However, this is not the intended usage.

Updates the CCR.

Implemented in Wi11.

7.9.3.15 virtual Codes::RESULT iWi11::_Store (const Decoder::REGISTER_ID *SR1*, const iWord & *address*) [private, pure virtual]

Stores a register's value into memory at a specified address.

Parameters

in	*SR1*	The source register (holds the data to be stored).
in	*address*	When concatenated with the PC, forms the address for the store.

Postcondition

SR1 and "address" are not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Implemented in Wi11.

7.9.3.16 virtual Codes::RESULT iWi11::_STI (const Decoder::REGISTER_ID *SR1*, const iWord & *address*) [private, pure virtual]

Performs an indirect store.

Parameters

in	*SR1*	The source register (holds the data to be stored).
in	*address*	A 9-bit offset to the PC.

Postcondition

"SR1" and "address" are not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Works similar to _Store() but when memory is read, it uses the address found to again access memory. In this indirect way, a store can be made to anywhere in Memory.

Implemented in Wi11.

7.9.3.17 virtual Codes::RESULT iWi11::_STR (const Decoder::REGISTER_ID *SR1*, const Decoder::REGISTER_ID *baseR*, const iWord & *address*) `[private, pure virtual]`

Perfroms a register-relative store.

Parameters

in	*SR1*	The source register (holds the data to be stored).
in	*baseR*	A register whose value acts as a base address.
in	*address*	A 6-bit index from the base address.

Postcondition

SR1, baseR, and "address" are not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Implemented in Wi11.

7.9.3.18 virtual Codes::RESULT iWi11::_Trap (const iWord & *code*) `[private, pure virtual]`

Branches to a trap vector.

Parameters

in	*code*	The trap code.

Postcondition

"code" is not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

The traps are as follows:

- 0x21 - OUT - Write the character formed from the eight least significant bits of R0 to standard out.
- 0x22 - PUTS - Write the a string to standard out starting at the address pointed to by R0 and ending at a null character.
- 0x23 - IN - Prompt for, and read, a single character from standard in. Re-print it and store its ascii value in R0 (with leading zeros).
- 0x25 - HALT - End execution and print an appropriate message to standard out.
- 0x31 - INN - Prompt for, and read, a positive decimal number from standard in. Re-print it and store it in R0 (the number must in 16-bit range).
- 0x43 - RND - Generate a random number and store it in R0.

Note

Traps 0x23, 0x31, and 0x43 all update the CCR.

Standard in is the keyboard.
Stardard out is the console.

Implemented in Wi11.

7.9.3.19 virtual bool iWi11::LoadObj (const char ∗ *filename*) [pure virtual]

Loads the object file and sets up memory as it describes.

Parameters

in	*filename*	The name of the object file.

Postcondition

"filename" is not changed.

Returns

True if and only if the load was successful.

If "false" is returned, prints an appropriate error message to the user.

Note

This fucntion can be called multiple times. Each time the PC is overwritten.

Implemented in Wi11.

7.9.3.20 virtual void iWi11::DisplayMemory ( ) const `[pure virtual]`

Prints the state of memory to standard out.

Postcondition

The calling object is not changed.

Implemented in Wi11.

7.9.3.21 virtual void iWi11::DisplayRegisters ( ) const `[pure virtual]`

Prints the state of every register to standard out.

Postcondition

The calling object is not changed.

The values of all 8 general purpose registers, the CCR, and PC are all printed.

Implemented in Wi11.

7.9.3.22 virtual bool iWi11::ExecuteNext (bool *verbose* = `false`) `[pure virtual]`

Executes the instruction pointed to by the PC.

Parameters

`in`	*verbose*	If true, machine state information is displayed after each step.

Returns

True if and only if the end of the program have been reached.

This function is the brains of the operation, so to speak. Almost the entire fetch-execute loop of the Wi-11 is present here. In particular, this function must interpret the instructions and manage the CCRs.

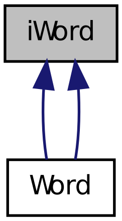
For a complete list of the instructions, see Wi-11 Instructions.

Implemented in Wi11.

7.10 iWord Class Reference

Defines a "word" of data on the Wi-11 Machine.

Inheritance diagram for iWord:



Public Member Functions

- virtual int ToInt () const =0

  "To non-negative Integer"

- virtual int ToInt2Complement () const =0

  "To Integer as 2's Complement"

- virtual std::string ToStr () const =0

  "To String"

- virtual std::string ToHex () const =0

  "To Hexadecimal"

- virtual bool FromInt (int value)=0

  "From Integer"

- virtual bool FromStr (const std::string &str)=0

  "From String"

- virtual bool FromHex (const std::string &str)=0

  "From Hexadecimal"

- virtual Word Add (const iWord &w) const =0

  Adds two words.

- virtual Word operator+ (const iWord &w) const =0

  A standard addition operator.

- virtual Word Subtract (const iWord &w) const =0

  Subtracts two words.

- virtual Word operator- (const iWord &w) const =0

  A standard subtraction operator.

- virtual Word And (const iWord &w) const =0

  "And"s the bits of two words.

- virtual Word Or (const iWord &w) const =0

  "Or"s the bits of two words.

- virtual Word Not () const =0

  "Not"s the bits of a word.

- virtual void Copy (const iWord &w)=0

  Copies a word.

- virtual Word & operator= (const Word w)=0

  A standard assignment operator.

- virtual iWord & operator++ ()=0

  A standard pre-increment operator.

- virtual iWord & operator++ (int)=0

  A standard post-increment operator.

- virtual bool operator[] (const int i) const =0

  An accessor to the 'i'th bit of the value.

- virtual int toInt () const =0

  "To non-negative Integer"

- virtual int toInt2Complement () const =0

  "To Integer as 2's Complement"

- virtual std::string toStr () const =0

  "To String"

- virtual std::string toHex () const =0

  "To Hexadecimal"

- virtual bool fromInt (int value)=0

  "From Integer"

- virtual bool fromStr (const std::string &str)=0

  "From String"

- virtual bool fromHex (const std::string &str)=0

  "From Hexadecimal"

- virtual Word Add (const iWord &w) const =0

  Adds two words.

- virtual Word operator+ (const iWord &w) const =0

  A standard addition operator.

- virtual Word Subtract (const iWord &w) const =0

  Subtracts two words.

- virtual Word operator- (const iWord &w) const =0

  A standard subtraction operator.

- virtual Word And (const iWord &w) const =0

  "And"s the bits of two words.

- virtual Word Or (const iWord &w) const =0

  "Or"s the bits of two words.

- virtual Word Not () const =0

  "Not"s the bits of a word.

- virtual void copy (const iWord &w)=0

  Copies a word.

- virtual Word & operator= (const Word w)=0

  A standard assignment operator.

- virtual iWord & operator++ ()=0

  A standard pre-increment operator.

- virtual iWord & operator++ (int)=0

  A standard post-increment operator.

- virtual bool operator[ ] (const int i) const =0

  An accessor to the 'i'th bit of the value.

7.10.1 Detailed Description

Defines a "word" of data on the Wi-11 Machine. The methods present in this inteface are meant to mimic the functionality of the Wi-11 machine, allowing for simplified execution of the instructions therein. As the size of a "word" depends on the architecture, classes implementing this interface should define the word length to be 16 bits in length.

7.10.2 Member Function Documentation

7.10.2.1 virtual int iWord::ToInt ( ) const `[pure virtual]`

"To non-negative Integer"

Postcondition

The value of the word is not changed.

Returns

The bits of the word interpreted as a positive integer value.

Implemented in Word.

7.10.2.2 virtual int iWord::ToInt2Complement ( ) const [pure virtual]

"To Integer as 2's Complement"

Postcondition

The value of the word is not changed.

Returns

The bits of the word interpreted as a signed (2's complement) integer value.

Implemented in Word.

7.10.2.3 virtual std::string iWord::ToStr ( ) const [pure virtual]

"To String"

Postcondition

The value of the word is not changed.

Returns

16 characters: each either a 1 or 0

Examples:

If the object holds a (2's comp.) value 4: "0000000000000100"
If the object holds a (2's comp.) value -1: "1111111111111111"

Implemented in Word.

7.10.2.4 virtual std::string iWord::ToHex ( ) const [pure virtual]

"To Hexadecimal"

Postcondition

The value of the word is not changed.

Returns

"0x" + <4 characters in the range [0-9],[A-F]>

Examples:

If the object holds (2's comp.) value 8: "0x0008"
If the object holds (2's comp.) value -2: "0xFFFE"

Implemented in Word.

7.10.2.5 virtual bool iWord::FromInt (int *value*) [pure virtual]

"From Integer"

Parameters

in	*value*	The value to be stored into the word.

Postcondition

"value" is not changed.

Returns

True if and only if "value" can be represented in 16 bits

When this function returns "False", the value of the word is unchanged.

Otherwise, the word now holds the value "value".

Implemented in Word.

7.10.2.6 virtual bool iWord::FromStr (const std::string & *str*) [pure virtual]

"From String"

Parameters

in	*str*	A string of characters meant to represent a "word" to be stored.

Postcondition

"str" is not changed.

Returns

True if and only if "str" is well-formed (as defined in toStr()).

When this function returns "False", the value of the word is unchanged.

Otherwise, the word now holds the value "str".

Implemented in Word.

7.10.2.7 virtual bool iWord::FromHex (const std::string & *str*) [pure virtual]

"From Hexadecimal"

Parameters

in	*str*	A string of characters meant to represent a "word" to be stored.

Postcondition

"str" is not changed.

Returns

True if and only if "str" is well-formed (as defined in toHex()).

When this function returns "False", the value of the word is unchanged.

Otherwise, the word now holds the value "str".

Implemented in Word.

7.10.2.8 virtual Word iWord::Add (const iWord & *w*) const [pure virtual]

Adds two words.

Parameters

in	*w*	A word value to be added.

Postcondition

Both "w" and the calling object do not change.

Returns

A new "Word" object containing result of adding "w" and the calling object.

Note

The addition is carried out with no regard to logical overflow.

Implemented in Word, and Word.

7.10.2.9 virtual Word iWord::operator+ (const iWord & *w*) const [pure virtual]

A standard addition operator.

Note

"result = p + w" is equivalent to "result = p.Add(w)".

Implemented in Word, and Word.

7.10.2.10 virtual Word iWord::Subtract (const iWord & *w*) const `[pure virtual]`

Subtracts two words.

Parameters

`in`	*w*	A word value to be subtracted.

Postcondition

Both "w" and the calling object do not change.

Returns

A new "Word" object containing the result of subtracting "w" from the calling object.

Note

The subtraction is carried out with no regard for logical overflow.

Implemented in Word, and Word.

7.10.2.11 virtual Word iWord::operator- (const iWord & *w*) const `[pure virtual]`

A standard subtraction operator.

Note

"result = p - w" is equivalent to "result = p.Subtract(w)".

Implemented in Word, and Word.

7.10.2.12 virtual Word iWord::And (const iWord & *w*) const `[pure virtual]`

"And"s the bits of two words.

Parameters

`in`	*w*	A word value to be "and"ed.

Postcondition

Both "w" and the calling object do not change.

Returns

A new "Word" object containing the result of performing a bit-wise and on "w" and the calling object.

Implemented in Word, and Word.

7.10.2.13 virtual Word iWord::Or (const iWord & *w*) const [pure virtual]

"Or"s the bits of two words.

Parameters

in	*w*	A word value to be "or"ed.

Postcondition

Both "w" and the calling object do not change.

Returns

A new "Word" object containing the result of performing a bit-wise or on "w" and the calling object.

Implemented in Word, and Word.

7.10.2.14 virtual Word iWord::Not ( ) const [pure virtual]

"Not"s the bits of a word.

Postcondition

The calling object do not change.

Returns

A new "Word" object containing the result of performing a bit-wise not on the calling object.

Implemented in Word, and Word.

7.10.2.15 virtual void iWord::Copy (const iWord & *w*) [pure virtual]

Copies a word.

Parameters

out	*w*	The value to be copied.

Postcondition

The caller equals that parameter.

Equivalent to the assignment "caller = parameter".

Implemented in Word.

7.10.2.16 virtual Word& iWord::operator= (const Word *w*) `[pure virtual]`

A standard assignment operator.

Parameters

`in`	*w*	The value to be copied.

Returns

A copy of the parameter.

The return value and parameter here must be declared as "Word"s as C++ does not work well with polymorphic assignment operators.

Implemented in Word, and Word.

7.10.2.17 virtual iWord& iWord::operator++ ( ) `[pure virtual]`

A standard pre-increment operator.

Returns

A reference to itself.

The object increments its value BEFORE the execution of the current line.

Implemented in Word, and Word.

7.10.2.18 virtual iWord& iWord::operator++ (int) `[pure virtual]`

A standard post-increment operator.

Returns

A reference to itself.

The object increments its value AFTER the execution of the current line.

Implemented in Word, and Word.

7.10.2.19 virtual bool iWord::operator[] (const int *i*) const [pure virtual]

An accessor to the 'i'th bit of the value.

Parameters

in	*i*	The index of the bit in question.

Precondition

The index must be less than the size of a word, ie. 16.

Returns

True <=> 1, False <=> 0.

The number of the bits starts at zero and rises into the more significant bits.

Examples:

If the object holds a value of 4 (0...100 in binary): num[2] = 1.
If it holds a value of 1 (0...001 in binary): num[0] = 1.
If it holds a negative value (Starting with a 1 in 2's complement): num[15] = 1.

Implemented in Word, and Word.

7.10.2.20 virtual int iWord::toInt ( ) const [pure virtual]

"To non-negative Integer"

Postcondition

The value of the word is not changed.

Returns

The bits of the word interpreted as a positive integer value.

Implemented in Word.

7.10.2.21 virtual int iWord::toInt2Complement ( ) const [pure virtual]

"To Integer as 2's Complement"

Postcondition

The value of the word is not changed.

Returns

The bits of the word interpreted as a signed (2's complement) integer value.

Implemented in Word.

7.10.2.22 virtual std::string iWord::toStr ( ) const `[pure virtual]`

"To String"

Postcondition

The value of the word is not changed.

Returns

16 characters: each either a 1 or 0

Examples:

If the object holds a (2's comp.) value 4: "0000000000000100"
If the object holds a (2's comp.) value -1: "1111111111111111"

Implemented in Word.

7.10.2.23 virtual std::string iWord::toHex ( ) const `[pure virtual]`

"To Hexadecimal"

Postcondition

The value of the word is not changed.

Returns

"0x" + <4 characters in the range [0-9],[A-F]>

Examples:

If the object holds (2's comp.) value 8: "0x0008"
If the object holds (2's comp.) value -2: "0xFFFE"

Implemented in Word.

7.10.2.24 virtual bool iWord::fromInt (int *value*) `[pure virtual]`

"From Integer"

Parameters

`in`	*value*	The value to be stored into the word.

Postcondition

"value" is not changed.

Returns

True if and only if "value" can be represented in 16 bits

When this function returns "False", the value of the word is unchanged.

Otherwise, the word now holds the value "value".

Implemented in Word.

7.10.2.25 virtual bool iWord::fromStr (const std::string & *str*) `[pure virtual]`

"From String"

Parameters

`in`	*str*	A string of characters meant to represent a "word" to be stored.

Postcondition

"str" is not changed.

Returns

True if and only if "str" is well-formed (as defined in toStr()).

When this function returns "False", the value of the word is unchanged.

Otherwise, the word now holds the value "str".

Implemented in Word.

7.10.2.26 virtual bool iWord::fromHex (const std::string & *str*) `[pure virtual]`

"From Hexadecimal"

Parameters

in	*str*	A string of characters meant to represent a "word" to be stored.

Postcondition

"str" is not changed.

Returns

True if and only if "str" is well-formed (as defined in toHex()).

When this function returns "False", the value of the word is unchanged.

Otherwise, the word now holds the value "str".

Implemented in Word.

7.10.2.27 virtual Word iWord::Add (const iWord & *w*) const [pure virtual]

Adds two words.

Parameters

in	*w*	A word value to be added.

Postcondition

Both "w" and the calling object do not change.

Returns

A new "Word" object containing result of adding "w" and the calling object.

Note

The addition is carried out with no regard to logical overflow.

Implemented in Word, and Word.

7.10.2.28 virtual Word iWord::operator+ (const iWord & *w*) const [pure virtual]

A standard addition operator.

Note

"result = p + w" is equivalent to "result = p.Add(w)".

Implemented in Word, and Word.

7.10.2.29 virtual Word iWord::Subtract (const iWord & *w*) const `[pure virtual]`

Subtracts two words.

Parameters

`in`	*w*	A word value to be subtracted.

Postcondition

Both "w" and the calling object do not change.

Returns

A new "Word" object containing the result of subtracting "w" from the calling object.

Note

The subtraction is carried out with no regard for logical overflow.

Implemented in Word, and Word.

7.10.2.30 virtual Word iWord::operator- (const iWord & *w*) const `[pure virtual]`

A standard subtraction operator.

Note

"result = p - w" is equivalent to "result = p.Subtract(w)".

Implemented in Word, and Word.

7.10.2.31 virtual Word iWord::And (const iWord & *w*) const `[pure virtual]`

"And"s the bits of two words.

Parameters

`in`	*w*	A word value to be "and"ed.

Postcondition

Both "w" and the calling object do not change.

Returns

A new "Word" object containing the result of performing a bit-wise and on "w" and the calling object.

Implemented in Word, and Word.

7.10.2.32 virtual Word iWord::Or (const iWord & *w*) const [pure virtual]

"Or"s the bits of two words.

Parameters

in	*w*	A word value to be "or"ed.

Postcondition

Both "w" and the calling object do not change.

Returns

A new "Word" object containing the result of performing a bit-wise or on "w" and the calling object.

Implemented in Word, and Word.

7.10.2.33 virtual Word iWord::Not ( ) const [pure virtual]

"Not"s the bits of a word.

Postcondition

The calling object do not change.

Returns

A new "Word" object containing the result of performing a bit-wise not on the calling object.

Implemented in Word, and Word.

7.10.2.34 virtual void iWord::copy (const iWord & *w*) [pure virtual]

Copies a word.

Parameters

out	*w*	The value to be copied.

Postcondition

The caller equals that parameter.

Equivalent to the assignment "caller = parameter".

Implemented in Word.

7.10.2.35 virtual Word& iWord::operator= (const Word *w*) [pure virtual]

A standard assignment operator.

Parameters

in	*w*	The value to be copied.

Returns

A copy of the parameter.

The return value and parameter here must be declared as "Word"s as C++ does not work well with polymorphic assignment operators.

Implemented in Word, and Word.

7.10.2.36 virtual iWord& iWord::operator++ ( ) [pure virtual]

A standard pre-increment operator.

Returns

A reference to itself.

The object increments its value BEFORE the execution of the current line.

Implemented in Word, and Word.

7.10.2.37 virtual iWord& iWord::operator++ (int) [pure virtual]

A standard post-increment operator.

Returns

A reference to itself.

The object increments its value AFTER the execution of the current line.

Implemented in Word, and Word.

7.10.2.38 virtual bool iWord::operator[] (const int *i*) const [pure virtual]

An accessor to the 'i'th bit of the value.

Parameters

in	*i*	The index of the bit in question.

Precondition

The index must be less than the size of a word, ie. 16.

Returns

True <=> 1, False <=> 0.

The number of the bits starts at zero and rises into the more significant bits.

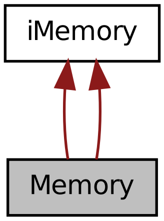
Examples:

If the object holds a value of 4 (0...100 in binary): num[2] = 1.
If it holds a value of 1 (0...001 in binary): num[0] = 1.
If it holds a negative value (Starting with a 1 in 2's complement): num[15] = 1.

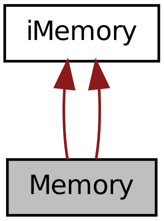
Implemented in Word, and Word.

7.11 Memory Class Reference

Inheritance diagram for Memory:



Collaboration diagram for Memory:



Public Member Functions

- virtual Codes::RESULT Reserve (const iWord &initial_address, const iWord &length)

  Reserves an initial section of memory for instructions.
- virtual Word Load (const iWord &) const

  Performs a load.
- virtual Codes::RESULT Store (const iWord &address, const Word &value)

  Peforms a store.
- virtual Codes::RESULT Reserve (const iWord &initial_address, const iWord &length)

  Reserves an initial section of memory for instructions.
- virtual Word Load (const iWord &) const

  Performs a load.
- virtual Codes::RESULT Store (const iWord &address, const Word &value)

  Peforms a store.

Private Attributes

- std::vector$<$ Word $*$ $>$ _bounded_memory

Provide constant time access to reserved memory.

- std::vector< int > _segment_offsets

  Keep track of the initial addresses.

- std::vector< int > _segment_lengths

  Keep track of the size of reserved memory.

- std::map< int, Word > _unbounded_memory

  Map out-of-bounds values to new Words.

7.11.1 Member Function Documentation

7.11.1.1 RESULT Memory::Reserve (const iWord & *initial_address,* const iWord & *length*) [virtual]

Reserves an initial section of memory for instructions.

Parameters

in	*initial_-address*	The smallest address for the instruction memory.
in	*length*	The number of addresses to reserve.

Returns

SUCCESS or, if something goes wrong, an appropriate error code.

The memory reserved here is dynamically allocated and provides constant-time access to addresses "initial_address" through "initial_address"+"length"-1.

Implements iMemory.

7.11.1.2 Word Memory::Load (const iWord & *w*) const [virtual]

Performs a load.

Parameters

in	*w*	The address from which to load data.

Returns

The data stored a address "w".

Note

If "w" is in the range created by Reserve(), it can be accessed in constant time. Otherwise, a maximum of nlogn time is required if n is the size of memory initialized outside of these boundaries.

Implements iMemory.

7.11.1.3 RESULT Memory::Store (const iWord & *address,* const Word & *value*) [virtual]

Peforms a store.

Parameters

in	*address*	The address to store the data.
in	*value*	The data to store at "address".

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

The efficiency constraints in Load() apply here as well.

Implements iMemory.

7.11.1.4 virtual Codes::RESULT Memory::Reserve (const iWord & *initial_address,* const iWord & *length*) [virtual]

Reserves an initial section of memory for instructions.

Parameters

in	*initial_address*	The smallest address for the instruction memory.
in	*length*	The number of addresses to reserve.

Returns

SUCCESS or, if something goes wrong, an appropriate error code.

The memory reserved here is dynamically allocated and provides constant-time access to addresses "initial_address" through "initial_address"+"length"-1.

Implements iMemory.

7.11.1.5 virtual Word Memory::Load (const iWord & *w*) const [virtual]

Performs a load.

Parameters

in	*w*	The address from which to load data.

Returns

The data stored a address "w".

Note

If "w" is in the range created by Reserve(), it can be accessed in constant time. Otherwise, a maximum of nlogn time is required if n is the size of memory initialized outside of these boundaries.

Implements iMemory.

7.11.1.6 virtual Codes::RESULT Memory::Store (const iWord & *address*, const Word & *value*) [virtual]

Peforms a store.

Parameters

in	*address*	The address to store the data.
in	*value*	The data to store at "address".

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

The efficiency constraints in Load() apply here as well.

Implements iMemory.

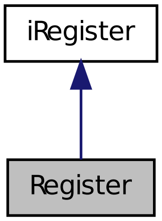
7.12 ObjectData Struct Reference

Public Attributes

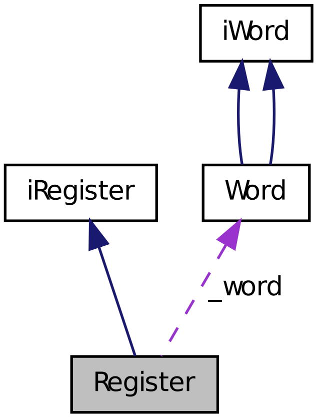
- char **type**
- std::vector< std::string > **data**

7.13 Register Class Reference

Inheritance diagram for Register:



Collaboration diagram for Register:



Public Member Functions

- **Register** (const Word w)
- Word GetValue () const

  Retrieves a copy of the word of data store in the register.

- void Add (const iWord &w)

  Adds a word of data to the calling object.

- Register Add (const iRegister &r) const

  Adds a word of data to the calling object.

- Register operator+ (const iRegister &r) const

  A standard add operator.

- void Subtract (const iWord &w)

  Subtracts a word of data from the calling object.

- Register Subtract (const iRegister &r) const

  Subtracts a word of data from the calling object.

- Register operator- (const iRegister &r) const

  A standard subtraction operator.

- void And (const iWord &w)

  Performs a bit-wise and.

- Register And (const iRegister &r) const

  Performs a bit-wise and.

- void Or (const iWord &w)

  Performs a bit-wise "or".

- Register Or (const iRegister &r) const

  Performs a bit-wise or.

- void Not ()

  Performs a bit-wise not.

- Register Not () const

  Performs a bit-wise not.

- void Store (const iWord &w)

Stores a word of data.

- void Store (const iRegister &r)

  Stores a copy of another register.

- Register & operator= (const iWord &w)

  A standard assignment operator.

- Register & operator= (const Register r)

  A standard assignment operator.

- Register & operator++ ()

  A standard pre-increment operator.

- Register & operator++ (int)

  A standard post-increment operator.

Private Attributes

- Word _word

  The word of data held in the register.

7.13.1 Member Function Documentation

7.13.1.1 Word Register::GetValue ( ) const `[virtual]`

Retrieves a copy of the word of data store in the register.

Postcondition

The value of the calling object is not changed.

Returns

A new Word object holding the value that is stored in the register.

Implements iRegister.

7.13.1.2 void Register::Add (const iWord & *w*) [virtual]

Adds a word of data to the calling object.

Parameters

in	*w*	The value to be added.

Postcondition

The calling object equals its previous value plus the value of "w"; "w", however, will remain unchanged.

Implements iRegister.

7.13.1.3 Register Register::Add (const iRegister & *r*) const [virtual]

Adds a word of data to the calling object.

Parameters

in	*r*	The value to be added.

Postcondition

Both the calling object and "r" will not be changed.

Returns

A new Register object holding the value of the calling object plus the value in "r".

Implements iRegister.

7.13.1.4 Register Register::operator+ (const iRegister & *r*) const [virtual]

A standard add operator.

Note

"result = p + r" is equivalent to "result = p.Add(r)".

Implements iRegister.

7.13.1.5 void Register::Subtract (const iWord & *w*) [virtual]

Subtracts a word of data from the calling object.

Parameters

in	*w*	The value to be subtracted.

Postcondition

> The calling object equals its previous value minus the value of "w"; "w", however, will remain unchanged.

Implements iRegister.

7.13.1.6 Register Register::Subtract (const iRegister & *r*) const [virtual]

Subtracts a word of data from the calling object.

Parameters

in	*r*	The value to be subtracted.

Postcondition

> Both the calling object and "r" will not be changed.

Returns

> A new Register object holding the value of the calling object minus the value in "r".

Implements iRegister.

7.13.1.7 Register Register::operator- (const iRegister & *r*) const [virtual]

A standard subtraction operator.

Note

> "result = p - r" is equivalent to "result = r.Subtract(w)".

Implements iRegister.

7.13.1.8 void Register::And (const iWord & *w*) [virtual]

Performs a bit-wise and.

Parameters

in	*w*	The value to be "and"ed.

Postcondition

The calling object equals its previous value bit-wise and'ed with w.

Implements iRegister.

7.13.1.9 Register Register::And (const iRegister & *r*) const [virtual]

Performs a bit-wise and.

Parameters

in	*r*	The value to be "and"ed.

Postcondition

Both the calling object and r are not changed.

Returns

A new Register object holding the value of the calling object bit-wise and'ed with r.

Implements iRegister.

7.13.1.10 void Register::Or (const iWord & *w*) [virtual]

Performs a bit-wise "or".

Parameters

in	*w*	The value to be "or"ed.

Postcondition

The calling object equals its previous value bit-wise or'ed with w.

Implements iRegister.

7.13.1.11 Register Register::Or (const iRegister & *r*) const [virtual]

Performs a bit-wise or.

Parameters

in	*r*	The value to be "or"ed.

Postcondition

Both the calling object and r are not changed.

Returns

A new Register object holding the value of the calling object bit-wise or'ed with r.

Implements iRegister.

7.13.1.12 void Register::Not ( ) [virtual]

Performs a bit-wise not.

Postcondition

The calling object's bits are all flipped (e.g. 1001 -> 0110).

Implements iRegister.

7.13.1.13 Register Register::Not ( ) const [virtual]

Performs a bit-wise not.

Postcondition

The calling object is not changed.

Returns

A new Register object holding the bit-wise not of the calling object.

Implements iRegister.

7.13.1.14 void Register::Store (const iWord & *w*) [virtual]

Stores a word of data.

Parameters

in	*w*	The value to be store.

Postcondition

The calling object's value is now "w".

Implements iRegister.

7.13.1.15 void Register::Store (const iRegister & *r*) `[virtual]`

Stores a copy of another register.

Parameters

`in`	*r*	The register to be copied.

Postcondition

> The calling object's value is now "r".

Implements iRegister.

7.13.1.16 Register & Register::operator= (const iWord & *w*) `[virtual]`

A standard assignment operator.

Note

> "r = w" is equivalent to "r.Store(w)"

Implements iRegister.

7.13.1.17 Register & Register::operator= (const Register *r*) `[virtual]`

A standard assignment operator.

Note

> "r1 = r2" is equivalent to "r1.Store(r2)"

Implements iRegister.

7.13.1.18 Register & Register::operator++ ( ) `[virtual]`

A standard pre-increment operator.

Returns

> A reference to itself.

The object increments its value BEFORE the execution of the current line.

Implements iRegister.

7.13.1.19 Register & Register::operator++ (int) [virtual]

A standard post-increment operator.

Returns

A reference to itself.

The object increments its value AFTER the execution of the current line.

Implements iRegister.

7.14 ResultDecoder Class Reference

Public Member Functions

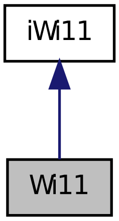
- std::string **Find** (const Codes::RESULT &) const
- std::string **Find** (const Codes::RESULT &) const

Static Private Attributes

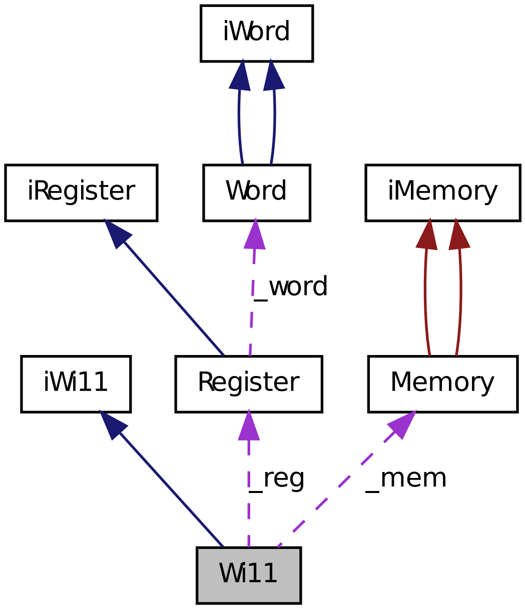
- static std::map< Codes::RESULT, std::string > **_codes**

7.15 Wi11 Class Reference

Inheritance diagram for Wi11:



Collaboration diagram for Wi11:



Public Member Functions

- bool LoadObj (const char ∗filename)

  Loads the object file and sets up memory as it describes.

- void DisplayMemory () const

  Prints the state of memory to standard out.

- void DisplayRegisters () const

  Prints the state of every register to standard out.

- bool ExecuteNext (bool verbose=false)

  Executes the instruction pointed to by the PC.

Private Member Functions

- iRegister & _GetRegister (const Decoder::REGISTER_ID &id)

  Retrieves a reference to the register corresponding to "id".

- Codes::RESULT _Add (const Decoder::REGISTER_ID DR, const Decoder::REGISTER_ID SR1, const Decoder::REGISTER_ID SR2)

  Adds two registers and stores the result in a third.

- Codes::RESULT _Add (const Decoder::REGISTER_ID DR, const Decoder::REGISTER_ID SR1, const iWord &immediate)

  Adds a constant to a register and stores the result in another.

- Codes::RESULT _And (const Decoder::REGISTER_ID DR, const Decoder::REGISTER_ID SR1, const Decoder::REGISTER_ID SR2)

  Bit-wise ands two registers and stores the result in a third.

- Codes::RESULT _And (const Decoder::REGISTER_ID DR, const Decoder::REGISTER_ID SR1, const iWord &immediate)

  Bit-wise ands a register with a constant and stores the result in another register.

- Codes::RESULT _Branch (const iWord &address)

  Changes the last 9 bits of the PC.

- Codes::RESULT _Debug ()

  Deprecated?

- Codes::RESULT _JSR (const iWord &w)

  Initiate a jump to a subroutine (alter the PC).

- Codes::RESULT _JSRR (const iWord &baseR, const iWord &address)

  Initiate a jump to a subroutine (alter the PC). param[in] baseR A register whose value acts as a base address.

- Codes::RESULT _Load (const Decoder::REGISTER_ID DR, const iWord &address)

  Loads a word in memory into a register.

- Codes::RESULT _LoadI (const Decoder::REGISTER_ID DR, const iWord &address)

  Performs an indirect load.

- Codes::RESULT _LoadR (const Decoder::REGISTER_ID DR, Decoder::REGISTER_ID baseR, const iWord &address)

Performs a register-relative load.

- Codes::RESULT _Not (const Decoder::REGISTER_ID DR, const Decoder::REGISTER_ID SR)

  Bit-wise nots a register and stores the result in another.

- Codes::RESULT _Ret ()

  Return from a subroutine.

- Codes::RESULT _Store (const Decoder::REGISTER_ID SR1, const iWord &address)

  Stores a register's value into memory at a specified address.

- Codes::RESULT _STI (const Decoder::REGISTER_ID SR1, const iWord &address)

  Performs an indirect store.

- Codes::RESULT _STR (const Decoder::REGISTER_ID SR1, const Decoder::REGISTER_ID baseR, const iWord &address)

  Perfroms a register-relative store.

- Codes::RESULT _Trap (const iWord &code)

  Branches to a trap vector.

Private Attributes

- Memory _mem

  Wi-11's memory.

- Register _reg [8]

  8 general purpose registers.

- bool _pos

  CCR, true iff positive.

- bool _zero

  CCR, true iff zero.

7.15.1 Member Function Documentation

7.15.1.1 iRegister& Wi11::_GetRegister (const Decoder::REGISTER_ID & *id*) [private, virtual]

Retrieves a reference to the register corresponding to "id".

Parameters

in	*id*	A REGISTER_ID corresponding to one of the private registers.

Returns

A reference to the id'd register.

Implements iWi11.

7.15.1.2 Codes::RESULT Wi11::_Add (const Decoder::REGISTER_ID *DR*, const Decoder::REGISTER_ID *SR1*, const Decoder::REGISTER_ID *SR2*) [private, virtual]

Adds two registers and stores the result in a third.

Parameters

out	*DR*	The destination register.
in	*SR1*	The first source register.
in	*SR2*	The second source register.

Postcondition

SR1 and SR2 are not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

Updates the CCR.

Implements iWi11.

7.15.1.3 Codes::RESULT Wi11::_Add (const Decoder::REGISTER_ID *DR*, const Decoder::REGISTER_ID *SR1*, const iWord & *immediate*) [private, virtual]

Adds a constant to a register and stores the result in another.

Parameters

out	*DR*	The destination register.
in	*SR1*	The source register.
in	*immediate*	The immediate value.

Postcondition

SR1 and "immediate" are not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

Updates the CCR.

Implements iWi11.

7.15.1.4 Codes::RESULT Wi11::_And (const Decoder::REGISTER_ID *DR*, const Decoder::REGISTER_ID *SR1*, const Decoder::REGISTER_ID *SR2*) [private, virtual]

Bit-wise ands two registers and stores the result in a third.

Parameters

out	*DR*	The destination register.
in	*SR1*	The first source register.
in	*SR2*	The second source register.

Postcondition

SR1 and SR2 are not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

Updates the CCR.

Implements iWi11.

7.15.1.5 Codes::RESULT Wi11::_And (const Decoder::REGISTER_ID *DR*, const Decoder::REGISTER_ID *SR1*, const iWord & *immediate*) `[private, virtual]`

Bit-wise ands a register with a constant and stores the result in another register.

Parameters

`out`	*DR*	The destination register.
`in`	*SR1*	The source register.
`in`	*immediate*	The immediate value.

Postcondition

SR1 and "immediate" are not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

Updates the CCR.

Implements iWi11.

7.15.1.6 Codes::RESULT Wi11::_Branch (const iWord & *address*) `[private, virtual]`

Changes the last 9 bits of the PC.

Parameters

`in`	*address*	The 9 bits to become the end of the PC.

Postcondition

"address" is not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Implements iWi11.

7.15.1.7 Codes::RESULT Wi11::_Debug ( ) `[private, virtual]`

Deprecated?

Does nothing.

Implements iWi11.

7.15.1.8 Codes::RESULT Wi11::_JSR (const iWord & *w*) `[private, virtual]`

Initiate a jump to a subroutine (alter the PC).

Parameters

`in`	*w*	A 9 bit offset for the PC.

Postcondition

The PC has "w" as its 9 least significant bits.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

If the link bit was set for this instruction, R7 will hold the old value of the PC. However, the CCR will not be altered for this instruction, depite R7 being altered.

Implements iWi11.

7.15.1.9 Codes::RESULT Wi11::_JSRR (const iWord & *baseR,* const iWord & *address*) `[private, virtual]`

Initiate a jump to a subroutine (alter the PC). param[in] baseR A register whose value acts as a base address.

Parameters

`in`	*address*	A 6 bit offset to the base address.

Postcondition

The PC is the value in baseR plus the value in address.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

If the link bit was set for this instruction, R7 will hold the old value of the PC. However, the CCR will not be altered for this instruction, depite R7 being altered.

Implements iWi11.

7.15.1.10 Codes::RESULT Wi11::_Load (const Decoder::REGISTER_ID *DR*, const iWord & *address*) [private, virtual]

Loads a word in memory into a register.

Parameters

out	*DR*	The destination register.
in	*address*	When concatenated with the PC, forms address in memory from which to load.

Postcondition

Memory and "address" have not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

Updates the CCR.

Implements iWi11.

7.15.1.11 Codes::RESULT Wi11::_LoadI (const Decoder::REGISTER_ID *DR*, const iWord & *address*) [private, virtual]

Performs an indirect load.

Parameters

out	*DR*	The destination register.
in	*address*	A 9-bit offset to the PC.

Postcondition

Memory and "address" have not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Works similar to _Load() but when memory is read, it uses the address found to again access memory. In this indirect way, a load can be made from anywhere in Memory.

Note

Updates the CCR.

Implements iWi11.

7.15.1.12 Codes::RESULT Wi11::_LoadR (const Decoder::REGISTER_ID *DR*, Decoder::REGISTER_ID *baseR*, const iWord & *address*) [private, virtual]

Performs a register-relative load.

Parameters

out	*DR*	The destination register.
in	*baseR*	A register whose value works as a base address.
in	*address*	An 6-bit index from the base address.

Postcondition

Memory, "baseR", and "address" have no changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Loads from "baseR" plus "address".

Note

Updates the CCR.

Implements iWi11.

7.15.1.13 Codes::RESULT Wi11::_Not (const Decoder::REGISTER_ID *DR*, const Decoder::REGISTER_ID *SR*) [private, virtual]

Bit-wise nots a register and stores the result in another.

Parameters

out	*DR*	The destination register.
in	*SR*	The source register.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

Updates the CCR.

Implements iWi11.

7.15.1.14 Codes::RESULT Wi11::_Ret ( ) [private, virtual]

Return from a subroutine.

Postcondition

The PC now holds the value that was (and still is) in R7.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Note

This can be used to jump anywhere in memory. However, this is not the intended usage.

Updates the CCR.

Implements iWi11.

7.15.1.15 Codes::RESULT Wi11::_Store (const Decoder::REGISTER_ID *SR1*, const iWord & *address*) [private, virtual]

Stores a register's value into memory at a specified address.

Parameters

in	*SR1*	The source register (holds the data to be stored).
in	*address*	When concatenated with the PC, forms the address for the store.

Postcondition

SR1 and "address" are not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Implements iWi11.

7.15.1.16 Codes::RESULT Wi11::_STI (const Decoder::REGISTER_ID *SR1*, const iWord & *address*) [private, virtual]

Performs an indirect store.

Parameters

in	*SR1*	The source register (holds the data to be stored).
in	*address*	A 9-bit offset to the PC.

Postcondition

"SR1" and "address" are not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Works similar to _Store() but when memory is read, it uses the address found to again access memory. In this indirect way, a store can be made to anywhere in Memory.

Implements iWi11.

7.15.1.17 Codes::RESULT Wi11::_STR (const Decoder::REGISTER_ID *SR1*, const Decoder::REGISTER_ID *baseR*, const iWord & *address*) [private, virtual]

Perfroms a register-relative store.

Parameters

in	*SR1*	The source register (holds the data to be stored).
in	*baseR*	A register whose value acts as a base address.
in	*address*	A 6-bit index from the base address.

Postcondition

SR1, baseR, and "address" are not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

Implements iWi11.

7.15.1.18 Codes::RESULT Wi11::_Trap (const iWord & *code*) [private, virtual]

Branches to a trap vector.

Parameters

in	*code*	The trap code.

Postcondition

"code" is not changed.

Returns

SUCCESS or, if something went wrong, an appropriate error code.

The traps are as follows:

- 0x21 - OUT - Write the character formed from the eight least significant bits of R0 to standard out.
- 0x22 - PUTS - Write the a string to standard out starting at the address pointed to by R0 and ending at a null character.
- 0x23 - IN - Prompt for, and read, a single character from standard in. Re-print it and store its ascii value in R0 (with leading zeros).
- 0x25 - HALT - End execution and print an appropriate message to standard out.
- 0x31 - INN - Prompt for, and read, a positive decimal number from standard in. Re-print it and store it in R0 (the number must in 16-bit range).
- 0x43 - RND - Generate a random number and store it in R0.

Note

Traps 0x23, 0x31, and 0x43 all update the CCR.

Standard in is the keyboard.
Stardard out is the console.

Implements iWi11.

7.15.1.19 bool Wi11::LoadObj (const char $*$ *filename*) [virtual]

Loads the object file and sets up memory as it describes.

Parameters

in	*filename*	The name of the object file.

Postcondition

"filename" is not changed.

Returns

True if and only if the load was successful.

If "false" is returned, prints an appropriate error message to the user.

Note

This fucntion can be called multiple times. Each time the PC is overwritten.

Implements iWi11.

7.15.1.20 void Wi11::DisplayMemory ( ) const [virtual]

Prints the state of memory to standard out.

Postcondition

The calling object is not changed.

Implements iWi11.

7.15.1.21 void Wi11::DisplayRegisters ( ) const [virtual]

Prints the state of every register to standard out.

Postcondition

The calling object is not changed.

The values of all 8 general purpose registers, the CCR, and PC are all printed.

Implements iWi11.

7.15.1.22 bool Wi11::ExecuteNext (bool *verbose* = `false`) `[virtual]`

Executes the instruction pointed to by the PC.

Parameters

`in`	*verbose*	If true, machine state information is displayed after each step.

Returns

True if and only if the end of the program have been reached.

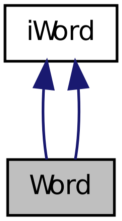
This function is the brains of the operation, so to speak. Almost the entire fetch-execute loop of the Wi-11 is present here. In particular, this function must interpret the instructions and manage the CCRs.

For a complete list of the instructions, see Wi-11 Instructions.

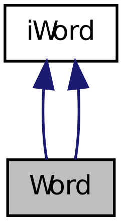
Implements iWi11.

7.16 Word Class Reference

Inheritance diagram for Word:



Collaboration diagram for Word:



Public Member Functions

- int toInt () const

  "To non-negative Integer"

- int toInt2Complement () const

  "To Integer as 2's Complement"

- std::string toStr () const

  "To String"

- std::string toHex () const

  "To Hexadecimal"

- bool fromInt (int value)

  "From Integer"

- bool fromStr (const std::string &str)

  "From String"

- bool fromHex (const std::string &str)

  "From Hexadecimal"

- Word Add (const iWord &w) const

  Adds two words.

- Word operator+ (const iWord &w) const

  A standard addition operator.

- Word Subtract (const iWord &w) const

  Subtracts two words.

- Word operator- (const iWord &w) const

  A standard subtraction operator.

- Word And (const iWord &w) const

  "And"s the bits of two words.

- Word Or (const iWord &w) const

  "Or"s the bits of two words.

- Word Not () const

  "Not"s the bits of a word.

- void copy (const iWord &w)

  Copies a word.

- Word & operator= (const Word w)

  A standard assignment operator.

- iWord & operator++ ()

  A standard pre-increment operator.

- iWord & operator++ (int)

  A standard post-increment operator.

- bool operator[] (const int i) const

  An accessor to the 'i'th bit of the value.

- int ToInt () const

  "To non-negative Integer"

- int ToInt2Complement () const

  "To Integer as 2's Complement"

- std::string ToStr () const

  "To String"

- std::string ToHex () const

  "To Hexadecimal"

- bool FromInt (int value)

  "From Integer"

- bool FromStr (const std::string &str)

  "From String"

- bool FromHex (const std::string &str)

  "From Hexadecimal"

- Word Add (const iWord &w) const

  Adds two words.

- Word operator+ (const iWord &w) const

  A standard addition operator.

- Word Subtract (const iWord &w) const

  Subtracts two words.

- Word operator- (const iWord &w) const

  A standard subtraction operator.

- Word And (const iWord &w) const

  "And"s the bits of two words.

- Word Or (const iWord &w) const

  "Or"s the bits of two words.

- Word Not () const

  "Not"s the bits of a word.

- void Copy (const iWord &w)

  Copies a word.

- Word & operator= (const Word w)

  A standard assignment operator.

- iWord & operator++ ()

  A standard pre-increment operator.

- iWord & operator++ (int)

  A standard post-increment operator.

- bool operator[] (const int i) const

  An accessor to the 'i'th bit of the value.

Private Member Functions

- bool _hasBit (int) const

  Tests for powers of two in binary representation.

- bool _HasBit (int) const

  Tests for powers of two in binary representation.

Private Attributes

- unsigned short _value

  Used to store the "word" of data.

7.16.1 Member Function Documentation

7.16.1.1 bool Word::_hasBit (int *i*) const [private]

Tests for powers of two in binary representation.

Parameters

i	The index of the digit desired from the binary representation of _word.

Returns

True if and only if the 'i'th bit is 1.

The indexing of the bits works as defined in operator[]().

7.16.1.2 int Word::toInt ( ) const [virtual]

"To non-negative Integer"

Postcondition

The value of the word is not changed.

Returns

The bits of the word interpreted as a positive integer value.

Implements iWord.

7.16.1.3 int Word::toInt2Complement ( ) const [virtual]

"To Integer as 2's Complement"

Postcondition

The value of the word is not changed.

Returns

The bits of the word interpreted as a signed (2's complement) integer value.

Implements iWord.

7.16.1.4 string Word::toStr ( ) const [virtual]

"To String"

Postcondition

The value of the word is not changed.

Returns

16 characters: each either a 1 or 0

Examples:

If the object holds a (2's comp.) value 4: "0000000000000100"
If the object holds a (2's comp.) value -1: "1111111111111111"

Implements iWord.

7.16.1.5 string Word::toHex ( ) const [virtual]

"To Hexadecimal"

Postcondition

The value of the word is not changed.

Returns

"0x" + <4 characters in the range [0-9],[A-F]>

Examples:

If the object holds (2's comp.) value 8: "0x0008"
If the object holds (2's comp.) value -2: "0xFFFE"

Implements iWord.

7.16.1.6 bool Word::fromInt (int *value*) `[virtual]`

"From Integer"

Parameters

`in`	*value*	The value to be stored into the word.

Postcondition

"value" is not changed.

Returns

True if and only if "value" can be represented in 16 bits

When this function returns "False", the value of the word is unchanged.

Otherwise, the word now holds the value "value".

Implements iWord.

7.16.1.7 bool Word::fromStr (const std::string & *str*) `[virtual]`

"From String"

Parameters

`in`	*str*	A string of characters meant to represent a "word" to be stored.

Postcondition

"str" is not changed.

Returns

True if and only if "str" is well-formed (as defined in toStr()).

When this function returns "False", the value of the word is unchanged.

Otherwise, the word now holds the value "str".

Implements iWord.

7.16.1.8 bool Word::fromHex (const std::string & *str*) [virtual]

"From Hexadecimal"

Parameters

in	*str*	A string of characters meant to represent a "word" to be stored.

Postcondition

"str" is not changed.

Returns

True if and only if "str" is well-formed (as defined in toHex()).

When this function returns "False", the value of the word is unchanged.

Otherwise, the word now holds the value "str".

Implements iWord.

7.16.1.9 Word Word::Add (const iWord & *w*) const [virtual]

Adds two words.

Parameters

in	*w*	A word value to be added.

Postcondition

Both "w" and the calling object do not change.

Returns

A new "Word" object containing result of adding "w" and the calling object.

Note

The addition is carried out with no regard to logical overflow.

Implements iWord.

7.16.1.10 Word Word::operator+ (const iWord & *w*) const [virtual]

A standard addition operator.

Note

"result = p + w" is equivalent to "result = p.Add(w)".

Implements iWord.

7.16.1.11 Word Word::Subtract (const iWord & *w*) const [virtual]

Subtracts two words.

Parameters

in	*w*	A word value to be subtracted.

Postcondition

Both "w" and the calling object do not change.

Returns

A new "Word" object containing the result of subtracting "w" from the calling object.

Note

The subtraction is carried out with no regard for logical overflow.

Implements iWord.

7.16.1.12 Word Word::operator- (const iWord & *w*) const [virtual]

A standard subtraction operator.

Note

"result = p - w" is equivalent to "result = p.Subtract(w)".

Implements iWord.

7.16.1.13 Word Word::And (const iWord & *w*) const [virtual]

"And"s the bits of two words.

Parameters

in	*w*	A word value to be "and"ed.

Postcondition

Both "w" and the calling object do not change.

Returns

A new "Word" object containing the result of performing a bit-wise and on "w" and the calling object.

Implements iWord.

7.16.1.14 Word Word::Or (const iWord & *w*) const [virtual]

"Or"s the bits of two words.

Parameters

in	*w*	A word value to be "or"ed.

Postcondition

Both "w" and the calling object do not change.

Returns

A new "Word" object containing the result of performing a bit-wise or on "w" and the calling object.

Implements iWord.

7.16.1.15 Word Word::Not ( ) const [virtual]

"Not"s the bits of a word.

Postcondition

The calling object do not change.

Returns

A new "Word" object containing the result of performing a bit-wise not on the calling object.

Implements iWord.

7.16.1.16 void Word::copy (const iWord & *w*) [virtual]

Copies a word.

Parameters

out	*w*	The value to be copied.

Postcondition

The caller equals that parameter.

Equivalent to the assignment "caller = parameter".

Implements iWord.

7.16.1.17 Word & Word::operator= (const Word *w*) [virtual]

A standard assignment operator.

Parameters

in	*w*	The value to be copied.

Returns

A copy of the parameter.

The return value and parameter here must be declared as "Word"s as C++ does not work well with polymorphic assignment operators.

Implements iWord.

7.16.1.18 iWord & Word::operator++ ( ) [virtual]

A standard pre-increment operator.

Returns

A reference to itself.

The object increments its value BEFORE the execution of the current line.

Implements iWord.

7.16.1.19 iWord & Word::operator++ (int) [virtual]

A standard post-increment operator.

Returns

A reference to itself.

The object increments its value AFTER the execution of the current line.

Implements iWord.

7.16.1.20 bool Word::operator[] (const int *i*) const [virtual]

An accessor to the 'i'th bit of the value.

Parameters

in	*i*	The index of the bit in question.

Precondition

The index must be less than the size of a word, ie. 16.

Returns

True <=> 1, False <=> 0.

The number of the bits starts at zero and rises into the more significant bits.

Examples:

If the object holds a value of 4 (0...100 in binary): num[2] = 1.
If it holds a value of 1 (0...001 in binary): num[0] = 1.
If it holds a negative value (Starting with a 1 in 2's complement): num[15] = 1.

Implements iWord.

7.16.1.21 bool Word::_HasBit (int *i*) const [private]

Tests for powers of two in binary representation.

Parameters

i	The index of the digit desired from the binary representation of _word.

Returns

True if and only if the 'i'th bit is 1.

The indexing of the bits works as defined in operator[]().

7.16.1.22 int Word::ToInt ( ) const [virtual]

"To non-negative Integer"

Postcondition

The value of the word is not changed.

Returns

The bits of the word interpreted as a positive integer value.

Implements iWord.

7.16.1.23 int Word::ToInt2Complement ( ) const [virtual]

"To Integer as 2's Complement"

Postcondition

The value of the word is not changed.

Returns

The bits of the word interpreted as a signed (2's complement) integer value.

Implements iWord.

7.16.1.24 string Word::ToStr ( ) const [virtual]

"To String"

Postcondition

The value of the word is not changed.

Returns

16 characters: each either a 1 or 0

Examples:

If the object holds a (2's comp.) value 4: "0000000000000100"
If the object holds a (2's comp.) value -1: "1111111111111111"

Implements iWord.

7.16.1.25 string Word::ToHex ( ) const [virtual]

"To Hexadecimal"

Postcondition

The value of the word is not changed.

Returns

"0x" + <4 characters in the range [0-9],[A-F]>

Examples:

If the object holds (2's comp.) value 8: "0x0008"
If the object holds (2's comp.) value -2: "0xFFFE"

Implements iWord.

7.16.1.26 bool Word::FromInt (int *value*) [virtual]

"From Integer"

Parameters

in	*value*	The value to be stored into the word.

Postcondition

"value" is not changed.

Returns

True if and only if "value" can be represented in 16 bits

When this function returns "False", the value of the word is unchanged.

Otherwise, the word now holds the value "value".

Implements iWord.

7.16.1.27 bool Word::FromStr (const std::string & *str*) [virtual]

"From String"

Parameters

in	*str*	A string of characters meant to represent a "word" to be stored.

Postcondition

"str" is not changed.

Returns

True if and only if "str" is well-formed (as defined in toStr()).

When this function returns "False", the value of the word is unchanged.

Otherwise, the word now holds the value "str".

Implements iWord.

7.16.1.28 bool Word::FromHex (const std::string & *str*) [virtual]

"From Hexadecimal"

Parameters

in	*str*	A string of characters meant to represent a "word" to be stored.

Postcondition

"str" is not changed.

Returns

True if and only if "str" is well-formed (as defined in toHex()).

When this function returns "False", the value of the word is unchanged.

Otherwise, the word now holds the value "str".

Implements iWord.

7.16.1.29 Word Word::Add (const iWord & *w*) const [virtual]

Adds two words.

Parameters

in	*w*	A word value to be added.

Postcondition

Both "w" and the calling object do not change.

Returns

A new "Word" object containing result of adding "w" and the calling object.

Note

The addition is carried out with no regard to logical overflow.

Implements iWord.

7.16.1.30 Word Word::operator+ (const iWord & *w*) const [virtual]

A standard addition operator.

Note

"result = p + w" is equivalent to "result = p.Add(w)".

Implements iWord.

7.16.1.31 Word Word::Subtract (const iWord & *w*) const [virtual]

Subtracts two words.

Parameters

in	*w*	A word value to be subtracted.

Postcondition

Both "w" and the calling object do not change.

Returns

A new "Word" object containing the result of subtracting "w" from the calling object.

Note

The subtraction is carried out with no regard for logical overflow.

Implements iWord.

7.16.1.32 Word Word::operator- (const iWord & *w*) const [virtual]

A standard subtraction operator.

Note

"result = p - w" is equivalent to "result = p.Subtract(w)".

Implements iWord.

7.16.1.33 Word Word::And (const iWord & *w*) const [virtual]

"And"s the bits of two words.

Parameters

in	*w*	A word value to be "and"ed.

Postcondition

Both "w" and the calling object do not change.

Returns

A new "Word" object containing the result of performing a bit-wise and on "w" and the calling object.

Implements iWord.

7.16.1.34 Word Word::Or (const iWord & *w*) const [virtual]

"Or"s the bits of two words.

Parameters

in	*w*	A word value to be "or"ed.

Postcondition

Both "w" and the calling object do not change.

Returns

A new "Word" object containing the result of performing a bit-wise or on "w" and the calling object.

Implements iWord.

7.16.1.35 Word Word::Not ( ) const [virtual]

"Not"s the bits of a word.

Postcondition

The calling object do not change.

Returns

A new "Word" object containing the result of performing a bit-wise not on the calling object.

Implements iWord.

7.16.1.36 void Word::Copy (const iWord & *w*) [virtual]

Copies a word.

Parameters

out	*w*	The value to be copied.

Postcondition

The caller equals that parameter.

Equivalent to the assignment "caller = parameter".

Implements iWord.

7.16.1.37 Word& Word::operator= (const Word *w*) [virtual]

A standard assignment operator.

Parameters

in	*w*	The value to be copied.

Returns

A copy of the parameter.

The return value and parameter here must be declared as "Word"s as C++ does not work well with polymorphic assignment operators.

Implements iWord.

7.16.1.38 iWord& Word::operator++ ( ) [virtual]

A standard pre-increment operator.

Returns

A reference to itself.

The object increments its value BEFORE the execution of the current line.

Implements iWord.

7.16.1.39 iWord& Word::operator++ (int) [virtual]

A standard post-increment operator.

Returns

A reference to itself.

The object increments its value AFTER the execution of the current line.

Implements iWord.

7.16.1.40 bool Word::operator[] (const int *i*) const [virtual]

An accessor to the 'i'th bit of the value.

Parameters

in	*i*	The index of the bit in question.

Precondition

The index must be less than the size of a word, ie. 16.

Returns

True <=> 1, False <=> 0.

The number of the bits starts at zero and rises into the more significant bits.

Examples:

> If the object holds a value of 4 (0...100 in binary): num[2] = 1.
> If it holds a value of 1 (0...001 in binary): num[0] = 1.
> If it holds a negative value (Starting with a 1 in 2's complement): num[15] = 1.

Implements iWord.

7.16.2 Member Data Documentation

7.16.2.1 unsigned short Word::_value `[private]`

Used to store the "word" of data.

The type "unsigned short" was chosen because in c++, shorts are 16bits (the same size as our words) and having it unsigned allows for easy "reading" as a positive int or a 2's complement int.

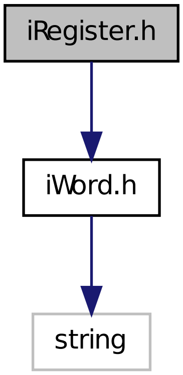
Chapter 8

File Documentation

8.1 iRegister.h File Reference

Definition of a "register" in the Wi-11 machine.

Include dependency graph for iRegister.h:



Classes

- class iRegister

  Defines a "register" in the Wi-11 machine.

8.1.1 Detailed Description

Definition of a "register" in the Wi-11 machine.

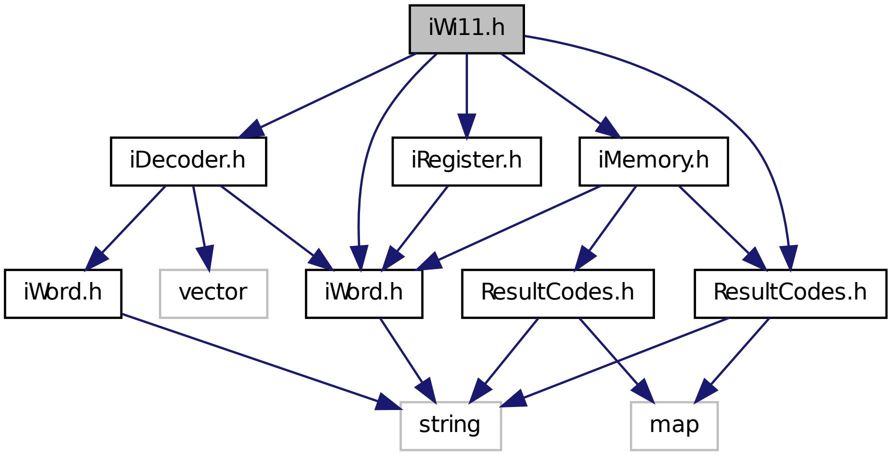
Author

Joshua Green
Andrew Groot

8.2 iWi11.h File Reference

Definition of the Wi-11 machine simulator.

Include dependency graph for iWi11.h:



Classes

- class iWi11

  Defines the internal logic of the Wi-11.

8.2.1 Detailed Description

Definition of the Wi-11 machine simulator.

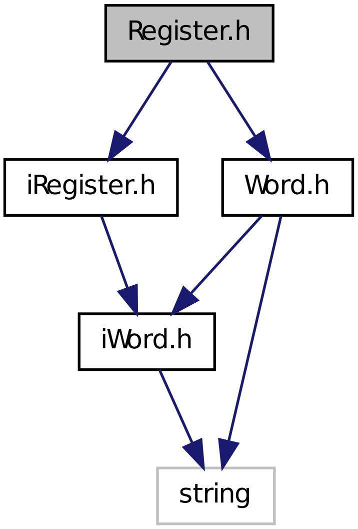
Author

Joshua Green
Andrew Groot

8.3 Register.h File Reference

Definition of private data for the "Register" class.

Include dependency graph for Register.h:



Classes

- class Register

8.3.1 Detailed Description

Definition of private data for the "Register" class.

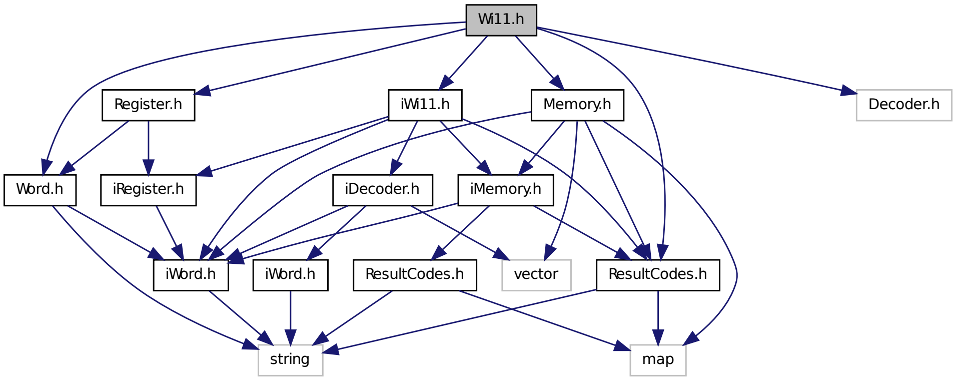
Author

Andrew Groot

8.4 Wi11.h File Reference

Definition of the private data for the "Wi11" class.

Include dependency graph for Wi11.h:



Classes

- class Wi11

8.4.1 Detailed Description

Definition of the private data for the "Wi11" class.

Author

Andrew Groot

Index