

Supplemental (course review) questions

1. Please explain how to transform an assembly language program into a binary executable file using the necessary reference tables.

Assembly Language is a low-level programming language. It helps in understanding the programming language to machine code. Assembly language is designed to understand the instruction and provide it to machine language for further processing. It mainly depends on the architecture of the system, whether it is the operating system or computer architecture.[1]

An assembler is a program that converts assembly language into machine code. It takes the basic commands and operations from assembly code and converts them into binary code that can be recognized by a specific type of processor.[2]

The opcode table is used by the assembler to translate assembly language into machine code. The opcode table is built into the assembler. There is a number assigned to each operation, which is the machine opcode which is generated by the compiler. It also has an assembly language representation which is a kind of intermediate human readable symbolic notation, and not intended for execution.

There is also a symbol table that is specific to an assembly language, and it is used during the translation to look up any symbols that are not located in the operations table.[3]

2. Please explain the formats of the different types of data (image, video, audio, and alphanumerical, integers, floating-point numbers).

Image –

Images used within the computer fall into two distinct categories.

Bitmap Images –

Bitmap representations are useful when there is a great amount of detail within an image, and for which the processing requirements are simple. The junction of each row and column of the image is a in the image known as a pixel. Corresponding to each pixel is a set of one or more binary numerical values that define the visual characteristics of that point.

The Graphics Interchange Format (GIF) – GIF assumes the existence of a rectangular screen upon which is located one or more rectangular images. Areas not covered with images are painted with a background color. The format divides the picture information and data into several blocks, each of which describes different aspects of the image. The pixel data is compressed, using an algorithm called LZW. LZW is called a lossless compression algorithm because it is reversible.

Portable Network Graphics (PNG) – PNG format is the best-known losslessly compressed alternative to GIF. PNG can store up to 48 bits of color per pixel, and additionally can store a transparency percentage value and a correction factor for the color in a monitor or printer. Its compression algorithm is often more efficient than that used with GIF. PNG stores only a single image in a file.

Joint Photographic Experts Group (JPEG) – JPEG format, employs a lossy compression algorithm to reduce the amount of data stored and transmitted, but the algorithm used reduces the image resolution under certain circumstances, particularly for sharp edges and lines. This makes JPEG more suitable for the representation of highly detailed photographs and paintings.

Object Images –

Object images are made up of simple elements like straight lines, curved lines (known as Bezier curves), circles and arcs of circles, ovals, and the like. Each of these elements can be defined mathematically by a small number of parameters.

PostScript page description language – The PostScript page description language is an example of a format that can be used to store, transmit, display, and print object images. A page description is a list of procedures and statements that describe each of the objects on a page. PostScript embeds page descriptions within a programming language. Thus, an image consists of a program written in the PostScript language.

Video –

The video format is determined by a codec, or encoder/decoder algorithm. There are several different standards in use. The best-known codec standards are MPEG-2, MPEG-4, and H.264.

MOV – MOV is a video format that was developed by Apple. It's an MPEG 4 video container file that is primarily used with Apple's QuickTime program. An MOV video can hold many different video formats and multimedia — audio, video, and text — in the same file on different tracks.

MP4 – MP4(short for MPEG-4 Part 14) is a file format based on QuickTime File Format but formally specifies support for Initial Object Descriptors (IOD) and other MPEG features. It is mostly used to store video and audio but can also be used to store subtitles and still images. MP4 is an international audio- visual coding standard. Like most modern container formats, MP4 supports streaming over the internet. Due to the high compression used in MP4, the resultant files are smaller in size with almost all the original quality retained.

Audio –

.WAV –The .WAV format was designed by Microsoft as part of its multimedia specification. The format supports 8- or 16-bit sound samples, sampled at 11.025 kHz, 22.05 kHz, or 44.1 kHz in mono or stereo. The .WAV format is very simple and does not provide support for a lot of features, such as the looping of sound blocks. .WAV data is not compressed. The format consists of a general header that identifies a “chunk” of data and specifies the length of a data block within the chunk. The header is followed by the data block. The general header is used for several different multimedia data types.

MP3 – MP3 is the predominant digital audio data format for the storage and transmission of music. It is characterized by reasonable audio quality and small file size. MP3 uses several different tactics and options to achieve its small file sizes. These include options for different audio sampling rates, fixed or variable bit rates, and a wide range of bit rates that represent different levels of compression. The bit rate, measured in kbits/second is directly related to the size of the file, however lower bit rates result in lower audio quality.

Alphanumeric Data –

The data entered as characters, symbols, number digits, and punctuation are known as alphanumeric data. Data if stored in code form

ASCII - The ASCII code was originally developed as a standard by the American National Standards Institute (ANSI). ANSI also has defined 8-bit extensions to the original ASCII codes that provide various symbols, line shapes, and accented foreign letters for the additional 128. Together, the 8-bit code is known as Latin-1. Latin-1 is an ISO (International Standards Organization) standard.

EBCDIC - EBCDIC was developed by IBM. Its use is restricted mostly to IBM and IBM-compatible mainframe computers and terminals. The Web makes EBCDIC particularly unsuitable for current work. The codes for each symbol are given in hexadecimal. EBCDIC is defined as an 8-bit code.

Unicode - Unicode supports approximately a million characters, using a combination of 8-bit, 16-bit, and 32-bit words. Unicode divides its character encodings into sixteen 16-bit code pages, called planes. There is a base plane plus fifteen supplementary planes, which allows space for about a million characters. Unicode defines three encoding methods, UTF-8, UTF-16, and UTF-32.

Integers –

The raw binary numbers stored in a computer can easily be interpreted to represent data of a variety of different types and formats.

The integer data type consists of positive or negative whole numbers. The string of characters representing a number is converted internally by a conversion routine built into the program by the compiler and stored and manipulated as a numerical value.

Floating-point numbers –

The raw binary numbers stored in a computer can easily be interpreted to represent data of a variety of different types and formats.

Floating point numbers are numbers with a decimal portion, or numbers whose magnitude, either small or large, exceeds the capability of the computer to process and store as an integer. The routine to convert a string of characters into a real number is built into the program.

References:

- [1] *What is assembly language?: Features: Advantages and disadvantages*. EDUCBA. (2021, March 30). Retrieved May 5, 2022, from <https://www.educba.com/what-is-assembly-language/>
- [2] *Assembler*. Assembler Definition. (n.d.). Retrieved May 5, 2022, from <https://techterms.com/definition/assembler>
- [3] *Assemblers*. Chapter 8: ASSEMBLERS. (n.d.). Retrieved May 5, 2022, from <http://www.jklp.org/profession/books/mix/c08.html>
- [4] Englander, I. (2014). Chapter 4 Data Formats. In *The architecture of computer hardware and systems software: An information technology approach* (5th ed., pp. 401–437). essay, Wiley.