Dordt University Name: dDB Key
Engineering 304, Embedded Microcontroller Systems, Spring 2020
Problem Set 1, Introductory Problems 10/10

2/2 1 **Glossary Items**.
Define these terms in ways that distinguish them from each other.

a.) General-purpose computer.
The traditional Windows, OSx, or Linux computer is a general-purpose computer. It is designed with lots of memory, typically more hard-drive storage space than needed (to accommodate any possible need) and is used primarily for information processing such as office work, social media, payrolls, etc.

b.) Embedded System
An embedded system is a computer used for somewhat dedicated purposes and in such a way that the device is not perceived as a computer. For example, the digital controls of a microwave oven amount to an embedded system. A television remote control is an embedded system. Embedded systems are configured with just enough resources (memory, I/O, clock speed, etc.) to get the job at hand done because any additional resources will not be used.

2 **Cyber-Physical Systems**.
In 200 words or less, explain the point of Figure 1.1 (on page 6) of the textbook.
2/2 In the text preceding the figure the authors explain that the textbook is about the intersection of the cyber and the physical. (Not the union—the scope of the text is more limited than that.) The top portion of the figure illustrates the cyber part of the system and the bottom portion illustrates the physical portion of the system. The entire system includes the physical plus one or more computers, plus the communications fabric (as needed) for the computers to talk to each other. This course lies on the boundary between the cyber and the physical.

3 **Development Environments.**
Describe what a development environment is and the essential tasks it performs.
2/2 A development environment is the set of software used to program a computer processor, in our case, to program a microcontroller. These programs typically include at least such things as an editor, a compiler, a linker, and a loader. In theory each of these programs could be supplied by a different vendor, with reliance on cut-and-paste or file I/O operations to transfer information between the various programs. An integrated development environment is a cohesive set of such programs that all communicate with each other. The "Arduino" program is an example of an IDE. Atmel, the manufacturer of the Atmega family of microcontrollers provides a different IDE called "Atmel Studio." The latest version is "Atmel Studio 7."

4 **CLI vs IDE.**
a.) Describe the advantages of a command-line interface (CLI) development environment.
A CLI provides a power level of control over every aspect of program development. Complex commands are available and they are easy to document and repeat exactly because they are all text. It is the de-facto industry standard way to develop large software projects.

b.) Describe the advantages of an integrated development environment (IDE).
An IDE provides a convenient user interface that puts all development task in your view. The tools are adapted and optimized for the target system. Project files are automatically tracked and kept organized regardless of location on the hard drive. Overall the process of writing and debugging code is more visible and easier to understand. Unfortunately most IDEs cannot provide the detailed level of control
2/2 that a CLI can.

5 **Arduino**.

Describe the chip that is at the heart of the Arduino Uno Board. Give the part number, type of package the chip is mounted in on the Arduino Uno board, and name some major features of this chip. Write up to 300 words, but no more.

The chip used on the Arduino Uno has part number "ATMEGA328P-PU." It is a microcontroller in a 28 pin dual in-line plastic (DIP) package with pins on 0.1 inch centers. This allows it to be mounted on a breadboard if so desired. This microcontroller runs on 5 V DC power. It has four main ports labeled A, B, C and D. In the 28 pin version of the Atmega port A has no external pin connections, but does exist and is addressable. Port A is an analog-to-digital converter. In order to use it one must use configuration information to switch some pins from Port C over to Port A. Port B is an 8-bit bi-directional digital I/O port.

2/2 Most of the bits in port B can be assigned special functions. Port C is a 7-bit bidirectional digital I/O port with high-current drivers. Port D is an 8-bit bidirectional digital I/O port. It has 32 KB of flash memory, 1 kB of EEPROM. and 2 kB of SRAM. It's clock speed can be 0 to 20 MHz.