ADDITIONAL INFORMATION

The file *CANdata.mat* contains data (table *CANdata*) recorded from the CAN bus. Each line in *CANdata* is transmitted at a certain timestamp. A line would typically look like:

Time stamp		*Identifier*				*Message (hex)*
0.0000	1	401	Rx	d	8	B9 D1 C4 8E 34 8F BA 00

where, for the exercise, you can neglect the fields marked with gray font.

The *message* field contains the raw data in hexadecimal (8 bytes). The advantage of a hexadecimal number is that is more compact than a binary number, that is it requires less digits. For example, the 8-byte hexadecimal number

B9 D1 C4 8E 34 8F BA 00

would translate into a binary number of 64 digits (bits). Note that each byte should be converted independently.

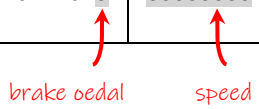
10111001 11010001 11000100 10001110 00110100 10001111 10111010 00000000.

Values from one or more signals may be transmitted in the same data frame. Data frames identified by the same identifier (e.g., 401) carry information on the same signals (see Table 1). For example, packets with identifier *401* contain information on vehicle speed and brake pedal. The way multiple signals are packed in the same data frame is by assigning a specified number of bits (size) in the message field for each signal (see Table 1). Each data frame has its own frequency of transmission (see Table 1).

The bits order is little endian and may be confusing at first. This means that we count bits from the least significant bit (LSB) to the most significant bit (MSB).

For example, vehicle speed occupies 8 bits, from the least significant bit at position 0 to the most significant bit at position 7 (Table 1). Then, in the same message, the brake pedal signal occupies just 1 bit at position 8 (Table 1). For the frame with identifier 401:

	MSB															*LSB*
Order	63	56	55	48	47	40	39	32	31	24	23	16	15	8	7	0
Message hexadecimal	B9		D1		C4		8E		34		8F		BA		00	
Message binary	10111001		11010001		11000100		10001110		00110100		10001111		10111010		00000000	



To convert the raw value of the signal to the physical value you also need to apply a *gain* and an *offset*, specific to each signal (see Table 1): $value_{physical} = value_{raw} \cdot gain + offset$. Note that if the min value of a signal is 0, the *offset* is 0.

Table 1. CAN data specifications.

Identifier	*Period (ms)*	*Signals*	*LSB*	*Size*	*Gain*	*Min value*	*Max value*	*Data type*	*Unit*
401	30								
		Vehicle speed	0	8	1	0	256	unsigned integer	km/h
		Brake pedal	8	1	1	0	1	unsigned integer	0:off, 1:on
59A	45								
		Clutch pedal position	24	8	0.392	0	100	unsigned integer	%
		Steering wheel position	32	16	0.011	-360	360	signed integer	degrees
1CC	65								
		Accelerator pedal position	16	10	0.098	0	100	unsigned integer	%