OLLSCOIL NA hÉIREANN MÁ NUAD
NATIONAL UNIVERSITY OF IRELAND MAYNOOTH

MUSIC

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MA in Computer Music/HDip in Music technology

MU611 Software Sound Synthesis

Dr. R. Climent; Professor G.T. Gillen; Dr. V. Lazzarini

Duration: Three Hours

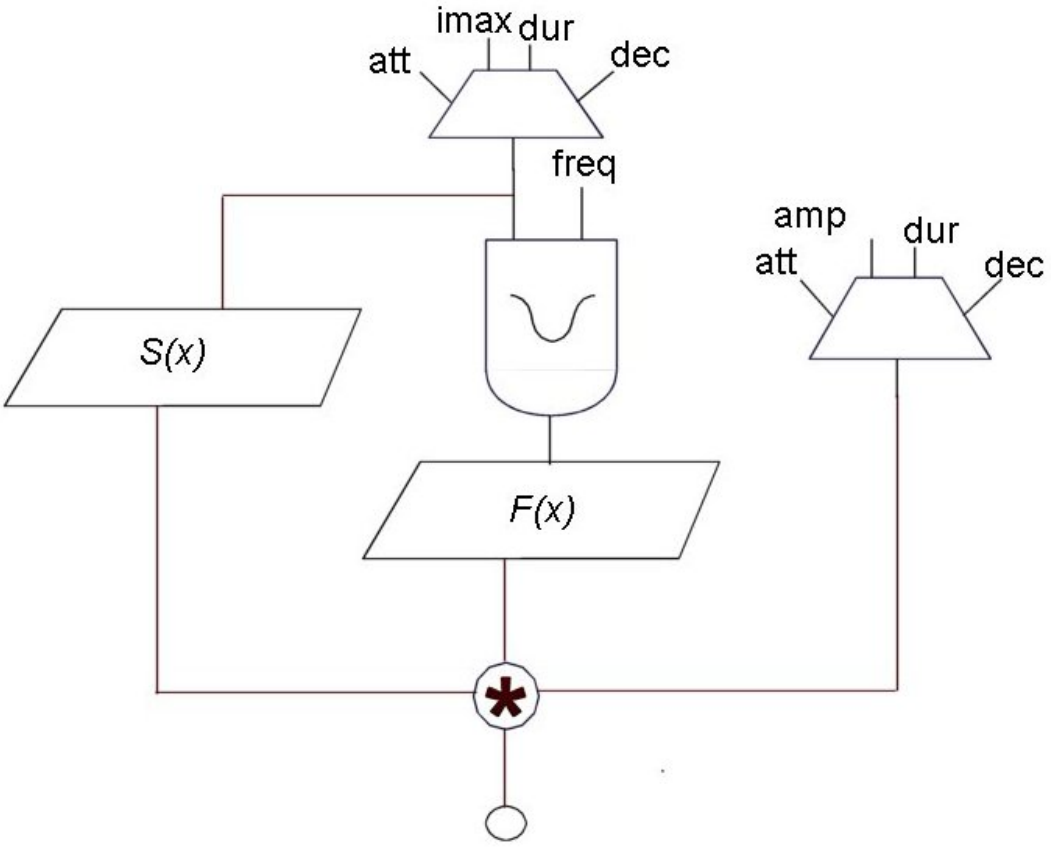
Please answer **four** *of the following five questions*

1. Consider a signal sampled at 48000 KHz and encoded in 24-bit using linear PCM:
   (a) What is the maximum dynamic range (in dB) and the maximum possible frequency range (in Hz) of this signal?
   (b) What is the Nyquist frequency?
   (c) The represented frequencies in a digital signal generated from an analog signal, sampled without any low-pass filtering, containing sine waves at 1000, 5000, 15000 and 25000 Hz.
   (d) What would be the cut-off frequency of a practical low-pass filter to prevent aliasing?

2. In relation to csound, please provide a definition for:
   (a) Orchestra and Score files.
   (b) Header.
   (c) instrument definitions.
   (d) opcodes and unit generators.
   (e) I-statements.
   (f) Function tables.
   (g) Pfields.

3. In FOF synthesis:
   (a) How does the bandwidth of a formant region relate to the so-called *local* envelope?
   (b) In this technique, what determines the formant centre frequency and the fundamental frequency?
   (c) How does the 'octaviation' parameter generate changes in octave in the resulting sound?
   (d) How does the technique relate to granular synthesis ?
   (e) How can we emulate aspects of formant synthesis with other techniques? Please describe at least one alternative method.

4. Implement the following flowchart as a csound instrument (including a complete score file with a few i-statements) according to the instructions below. Provide a description of what this instrument does. A csound opcode reference summary is provided in annex to this question sheet.



$F(x) = 12.8x^7 - 12.8x^5 + 1.2x^3 + 1.1x$ over -1 : 1

S(x) = 1/*running_abs_max*(F(x)) over 0 : 1

where *running_abs_max*(F(x)) returns the maximum absolute value so far of F(x) and F(-x).

5. In physical model synthesis, how is a waveguide implemented? How can we tune it to a particular fundamental (coarsely and finely)? Detail the basic design of the Karplus-Strong algorithm, outline it using a signal-flowchart and provide a csound instrument code for it.