screen: a crude form of animation!

The Commodore character code for a space is 32. All that is necessary is for the program to place this in the appropriate location, one place behind where the new A is about to be displayed. Insert this line into the above program:

35 POKE 1024+X,32

Alternatively,

15 POKE 1024+(X− 1),32

Having to POKE locations with numbers to produce graphics is a laborious process. The method is probably best used to create static background displays using READ and DATA statements to enter the character codes before POKEing them to the correct location.

Most home computers have many graphics commands as part of the standard BASIC instruction set, allowing the user to create impressive and colourful displays using only a few simple statements. Commands to construct geometric patterns in high resolution are often included. With these instructions the user can plot points on the screen and connect them with straight lines; draw squares, arcs and circles; and colour the interiors of the shapes drawn.

It is often a straightforward matter to replot old shapes with the same colour as the background, which has the effect of rubbing them out. Rapid plotting, rubbing out and replotting at a new position is, in fact, the basis of simple graphic animation. The realism of the action largely depends on the speed at which the process can be achieved. Sprites are much more effective because they do not require unplotting as they move to a new position, and this greatly improves the speed at which they appear to move. Indeed, the development of sprites means that for the first time it is possible to write arcade-style games in BASIC, where previously machine code was essential.

The principles of moving graphics can be used in conjunction with simple BASIC programs. Many home computers have commands that allow the user to PRINT at specific positions on the screen, such as PRINT AT on the Spectrum and PRINT@ on the Dragon.

Star Formation
Here is a short program for the Dragon using PRINT. In this the variable X is the screen location where the star is to be printed. Notice that line 40 rubs out the old star as the new one is PRINTed.

```
10 CLS: REM CLEAR
   SCREEN
20 FOR X = 160 TO 191
30 PRINT@X," * ";
40 PRINT@X−1," ";
50 NEXT X
60 END
```

Waveform

The waveform is the repetitive 'shape' of the signal produced by an oscillator (see page 247) and gives the sound its character. Two different instruments playing notes of the same pitch do not sound the same, and this is partly because the waveforms are different. The most common waveforms are square (or pulse), triangle and sawtooth — as shown in the panel.

Most home computers provide only one waveform, usually of the pulse type. This is why many have that unmistakable harsh synthetic sound.

Square

Sawtooth

Triangle
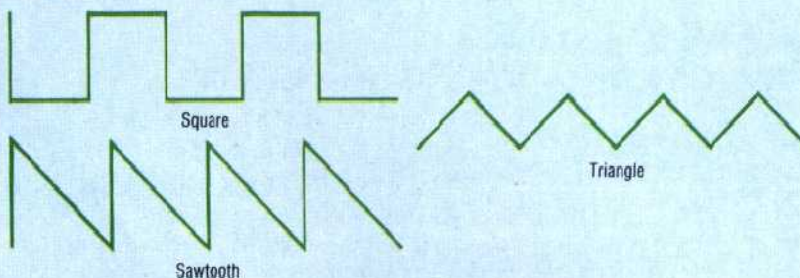
The Commodore 64 is currently the most interesting computer musically, mainly because you can select any of the three basic waveforms on each of three oscillators. The waveforms can be modified by the use of filters, which alter the tone in much the same manner as the bass/treble controls on a hi-fi and have the effect of mellowing the sound. Even more useful is the ability to change these filter settings throughout the duration of a note. This enables you to simulate natural sounds more closely and produce more exciting unnatural sounds.

Noise

Noise is a complex type of sound made by random vibrations. The ear cannot pick out a repetitive pattern, so it does not hear any specific pitch. Imagine some everyday sounds like rain, wind and thunder. These noises do not sound the same because they are a combination of pure (unpredictable) noise with some dominant tones. Most microcomputers with a noise facility therefore allow you to modulate the noise in some way, or to mix it with pure notes. The possible effects range from 'whistling wind' to violent explosions.

Output

Output is usually through the television speaker. If this is the case you can connect the television set to your hi-fi via a video recorder. Some computers, however, can output sound only through a small built-in speaker. For these it is impossible to obtain good quality sound without modifying the hardware of the computer or buying an external add-on. Your computer may have an output suitable for connection directly to your hi-fi, making the effort involved in producing complex sound shapes worthwhile.