# Aesthetics of Computer Science

Are the natural sciences and specifically computer science the subject of aesthetic thought? If so, what are the principal values of these aesthetics? This question will be examined in the following by relating to art, the traditional target of aesthetic considerations.

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The term *aesthetics* is commonly described as the theory or the understanding of beauty. To state a broader definition, I will define aesthetics as:

*the understanding of that which cause an emotional response through perception.*

Usually, the term is used in conjunction with art. The state of mind that is a requisite for aesthetic experiences is the state of mind that allows us to enjoy art. The observer must be subjective and emotionally sensitive, and must disregard prejudice and rational thought.

A generally accepted distinction of concepts in the sciences of art is that of the *recipe*, the *physical realization*, and the *artwork* itself[4]. The recipe is information describing the artwork as unambigously as possible, the physical realization is the object causing the emotional response through perception, and the artwork itself is the abstract idea forming a basis for the recipe. This idea should then be echoed in the emotions invoked in perceivers of the physical realization.

To clarify, let us review the distinction in the case of a musical composition. Here, the recipy is a score, a computer sequence or the sound wave data stored on a compact disc. The physical realization is the pressure level changes caused by instruments or loudspeakers. The artwork is the *ideas* of the composition, the melodies, the harmonies, and the rhythms. These ideas are the true objects of the aesthetic experience of music.

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Software can be used as artistic tools; trivial examples include text processing for authors, graphics software for visual artists, modelling software for architects, and score writing software for composers. In this use, computers are basically a replacement for pen and paper, brushes and canvas, etc. A more interesting application is *generative art*. Here, the artwork is essentially an algorithm, which through implementation (creation of a recipe) and execution outputs a physical realization of the

artwork. This technique has been pioneered by composers such as *Iannis Xenakis*.

According to Immanuel Kant, aesthetics do not require a work of art. In fact, Kant proposes that the purest aesthetic experience is that of nature [2]. Another possible application of aesthetics could be the scientific *interpretation* of nature. Natural scientists often make observations about the "beauty" of theoretical constructs acting as interpretations of nature. In the world of arts, aesthetics of interpretation are well-known. For instance, pursuers of the art of photography are concerned with interpretation of their subject.

Albert Einstein disliked the *cosmological constant* ($\Lambda$) in his *field equation:*

$$R_{ab} - \frac{R}{2} g_{ab} + \Lambda g_{ab} = \frac{8\pi G}{c^4} T_{ab}$$

for aesthetic reasons [1]. The natural scientific notion of aesthetics seems to require *simplicity* and, in the case of descriptive natural sciences such as physics, consistence with observations. Sir Isaac Newton's model of universal gravitation and James Clerk Maxwell's laws of electricity and magnetism have been hailed as "beautiful" for their simplicity and correctness.

Aesthetics of art doesn't seem to require simplicity. On the contrary, art may require complexity to capture the interest of the trained observer. Some schools of art are even preoccupied with *extreme* complexity. Musical genres such as *Jazz Fusion* or *Intelligent Dance Music* (IDM) are examples of this phenomenon.

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Is it possible to find aesthetics unique to the field of computer science? Every year for the last 18 years, a competition called *The International Obfuscated C Code Contest* or IOCCC [3] has been held. The goal of this competition is to write obscure and confusing C programs. Any programmer can write an unreadable program, but to win this competition, a program must have values beyond that. Highly ranked entries in the competition include:

**gavare.c** - the source code of which is a square block of text, with the letters IOCCC RAY represented as empty spaces in the middle (see Figure 1 on page 4). When compiled and run, the program produces as output a 3D rendering of the letters IOCCC RAY using *raytracing*[1] (see Figure 2 on page 4).

**westley.c** - is a text-based adventure game, where the output is transmitted solely through error messages from the compiler.

**smr.c** - was entered as the shortest *self-replicating program* ever. When compiled and run, a self-replicating program must produce the source code of the program itself as output [2]. smr.c is the shortest of such programs, as it is *an empty file* that when compiled and run produces, well, nothing.

None of these programs are of any practical use, and they are intentionally hard to understand. So, on what basis are they judged? The programmers exhibit creativity and originality, their programs inspire emotions of interest, confusion, and humour. This is evident from the comments of the judging committee. Thus, the programs are judged from aesthetic values. The evaluation of these programs is also interesting from an artistic point of view; they are evaluated not only on their underlying ideas, but also on the aesthetic value of their *recipes*, the source code layout.

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This discussion has shown that the natural sciences and specifically computer science *are* interpreted from an aesthetic point of view by its practitioners.

The natural sciences seem to value simplicity, where art also places importance on complexity. The reason for the value of simplicity in descriptive sciences could be that the goal of these is to create models of the world. If these models are sufficiently simple, they allow simplification of the perceived world. Such simplification of perception is also one of the primary functions of our human brains.

[1] An optical simulation based on tracing beams of light from an observer to a light source

[2] Self-replicating programs are interesting when perceived in an artistic context, as the *recipe* is exactly the same as the *physical realization*.

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X=1024; Y=768; A=3;

J=0;K=-10;L=-7;M=1296;N=36;O=255;P=9;_=1<<15;E;S;C;D;F(b){E="1""111886:6:??AAF"
"FHHMMOO55557799@@>>>BBBGGIIKK"[b]-64;C="C@=::C@@==@=:C@=:C@=:C5""31/513/5131/"
"31/531/53"[b ]-64;S=b<22?9:0;D=2;}I(x,Y,X){Y?(X^=Y,X*X>x?(X^=Y):0,  I (x,Y/2,X
)):(E=X);      }H(x){I(x,    _,0);}p;q(        c,x,y,z,k,l,m,a,          b){F(c
);x-=E*M     ;y-=S*M           ;z-=C*M         ;b=x*       x/M+         y*y/M+z
*z/M-D*D    *M;a=-x             *k/M     -y*l/M-z        *m/M;    p=((b=a*a/M-
b)>=0?(I    (b*M,_      ,0),b    =E,      a+(a>b      ?-b:b)):     -1.0);}Z;W;o
(c,x,y,     z,k,l,    m,a){Z=!    c?      -1:Z;c     <44?(q(c,x         ,y,z,k,
l,m,0,0     ),(p>      0&&c!=     a&&        (p<W         ||Z<0)          )?(W=
p,Z=c):     0,o(c+         1,    x,y,z,         k,l,          m,a)):0     ;}Q;T;
U;u;v;w    ;n(e,f,g,           h,i,j,d,a,    b,V){o(0      ,e,f,g,h,i,j,a);d>0
&&Z>=0? (e+=h*W/M,f+=i*W/M,g+=j*W/M,F(Z),u=e-E*M,v=f-S*M,w=g-C*M,b=(-2*u-2*v+w)
/3,H(u*u+v*v+w*w),b/=D,b*=b,b*=200,b/=(M*M),V=Z,E!=0?(u=-u*M/E,v=-v*M/E,w=-w*M/
E):0,E=(h*u+i*v+j*w)/M,h-=u*E/(M/2),i-=v*E/(M/2),j-=w*E/(M/2),n(e,f,g,h,i,j,d-1
,Z,0,0),Q/=2,T/=2,       U/=2,V=V<22?7:  (V<30?1:(V<38?2:(V<44?4:(V==44?6:3))))
,Q+=V&1?b:0,T               +=V&2?b        :0,U+=V    &4?b:0)     :(d==P?(g+=2
,j=g>0?g/8:g/     20):0,j    >0?(U=     j    *j/M,Q      =255-    250*U/M,T=255
-150*U/M,U=255    -100    *U/M):(U    =j*j     /M,U<M           /5?(Q=255-210*U
/M,T=255-435*U           /M,U=255    -720*      U/M):(U       -=M/5,Q=213-110*U
/M,T=168-113*U    /       M,U=111               -85*U/M)      ),d!=P?(Q/=2,T/=2
,U/=2):0);Q=Q<    0?0:      Q>O?     O:          Q;T=T<0?    0:T>O?O:T;U=U<0?0:
U>O?O:U;}R;G;B    ;t(x,y     ,a,    b){n(M*J+M    *40*(A*x   +a)/X/A-M*20,M*K,M
*L-M*30*(A*y+b)/Y/A+M*15,0,M,0,P,  -1,0,0);R+=Q    ;G+=T;B   +=U;++a<A?t(x,y,a,
b):(++b<A?t(x,y,0,b):0);}r(x,y){R=G=B=0;t(x,y,0,0);x<X?(printf("%c%c%c",R/A/A,G
/A/A,B/A/A),r(x+1,y)):0;}s(y){r(0,--y?s(y),y:y);}main(){printf("P6\n%i %i\n255"
"\n",X,Y);s(Y);}
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Figure 1: gavare.c

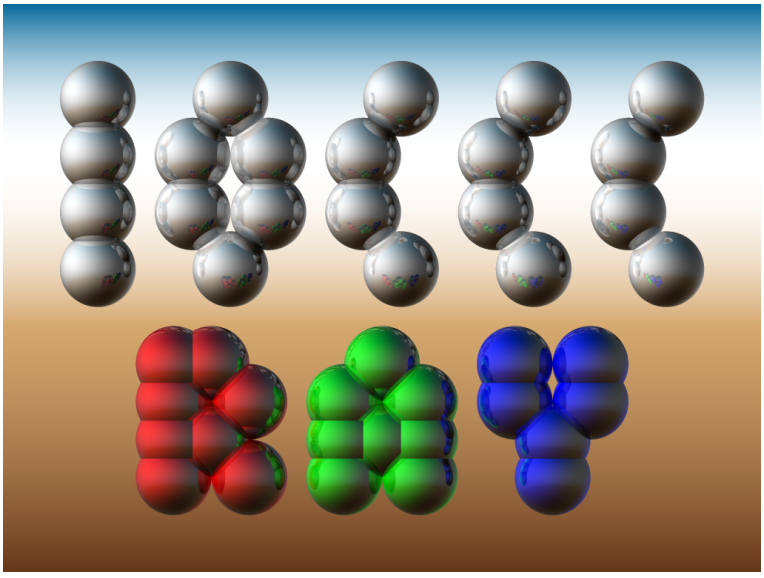

Figure 2: Output of gavare.c

# References

[1] Albert Einstein. *Relativity : the Special and General Theory*. Project Gutenberg, 2004. http://www.gutenberg.org.

[2] Immanuel Kant. *The Critique of Judgement*. The University of Adelaide Library eBooks, 2004. http://etext.library.adelaide.edu.au/.

[3] Peter Seebach Landon Curt Noll, Simon Cooper and Leonid A. Broukhis. The international obfuscated c code contest, 2003. http://ioccc.org/.

[4] Hartley Slater. The internet encyclopedia of philosophy - aesthetics, 2004. http://www.iep.utm.edu/a/aestheti.htm.

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