CS 133 Assignment 1

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1. Convert the following numbers from decimal to binary
   a) 217.75
      Binary: **11011001.11**
   b) -14.125
      Binary: **-1110.001**

2. Convert the following numbers from binary to decimal
   a) 11011.0011
      Decimal: **27.1875**
   b) -0.0101
      Decimal: **-0.3125**

3. Represent the following binary real number as a single-precision floating point number
   Binary: 11011.0011
      Normalized representation: $1.10110011 \times 10^{100}$
      Mantissa: 1.10110011
      Exponent: 100
      Sign bit: 0
      Adjusted exponent: 1000 0011
      Adjusted mantissa: 1011 0011 0000 0000 0000 000

      Single-precision floating point number representation:
      0 1000 0011 1011 0011 0000 0000 0000 000

4. Use the figure below to answer the following questions

   a) Represent the vector a= AB in Cartesian representation
      a = (2, -2)
   b) Compute the angle between AB and the positive x-axis
      Angle between AB and +x-axis = $\tan^{-1}(y/x)$
      $\theta = \tan^{-1}(2/2)$ = **45 degree**
   c) Compute the angle between BD and the positive x-axis
      Angle between BD and +x-axis = tan-1(y/x)
      $\theta = \tan^{-1}(2/2)$ = **45 degree**
   d) Compute the angle between AB and BD
      Angle between AB and BD = (180 – θs from (a) and (b))
      $\theta = 180 - 45 - 45$ = **90 degree**

e) Compute the cross product AB x BD in 2 different ways

Let 'AB' be 'a' and 'BD' be 'b'. Such that 'AB x BD' is 'a x b'

1. $a \times b = ||a||||b||\sin(\theta)n$

   => $||a|| = \text{sqrt}(a_1^2 + a_2^2) = \text{sqrt}(4 + 4) = 2.828$

   => $||b|| = \text{sqrt}(a_1^2 + a_2^2) = \text{sqrt}(4 + 4) = 2.828$

   => $a \times b = (2.828)(2.828)\sin(90)n = 0$

   => Thus, AB x BD = **0**

2. $a \times b = a_1b_2 - a_2b_1$

   => $(2*2) - (2*2) = 0$

   => Thus, AB x BD = **0**

f) Compute the dot product AB · BD in 2 different ways

1. $a \cdot b = ||a||||b||\cos(\theta)$

   => $||a|| = \text{sqrt}(a_1^2 + a_2^2) = \text{sqrt}(4 + 4) = 2.828$

   => $||b|| = \text{sqrt}(a_1^2 + a_2^2) = \text{sqrt}(4 + 4) = 2.828$

   => $a \cdot b = (2.828)(2.828) = 8$

   => Thus, AB · BD = **8**

2. $a \cdot b = a_1b_1 + a_2b_2$

   => $(2*2 + 2*2) = 8$

   => Thus, AB · BD = **8**

g) Compute the coordinates of the intersection between B'D and A'C

Here, B' = inverse of B => B'(0, 2)

A' = inverse of A => A'(2, 0)

Converting B'D and A'C to y-equation:

B'D => y = 0x + 2

A'C => y = 1/3x – 2/3

Then, with two equations for the two lines B'D and A'C, the intersection point is **(8, 2)**