NERS544: (Introduction to) Monte Carlo Methods

Assignment 5: **Planar geometry** 1-week assignment, weight = 1 Fall 2016

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The particle interaction scheme we shall consider is that of isotropic scattering

```
% Matlab sample code:
u = rotate(u,1 - 2*rand); % Deflects the particle's direction vector into a
                          % random and isotropic direction.
```

and forward scattering:

```
% Matlab sample code:
% There is no chage of particle direction
```

with a scattering constant, $\Sigma_{\rm scat}$, and particle absorption with the constant, $\Sigma_{\rm abs}$.
In this example, $\Sigma_{\rm scat} = 1$ cm^{-1} and $\Sigma_{\rm abs} = 0.05$ cm^{-1}.

To sample both scattering and absorption, consider

```
% Matlab sample code in the area where global constants are defined
Sscat = 1;    % Macroscopic scattering cross section (1/cm)
Sabs  = 0.05; % Macroscopic scattering cross section (1/cm)
Stot  = Sscat + Sabs; % Macroscopic total cross section (1/cm)
fscat = Sscat/Stot;   % Fraction of interaction events that are scatters
fabs  = Sabs/Stot;    % Fraction of interaction events that are absorbtions
.
.
.
% Matlab sample code in the area where distance to interaction is defined
t0 = -log(rand)/Stot; % Distance to the interaction point
.
.
.
.
if (rand < fscat)
   % It is a scattering event, deflect particle
   % Code this on your own
else
   % It is an absorbtion
   % Code this on your own
end
```

The particles are incident normally on the z-axis:

```
% Matlab sample code:
x = [0,0,0] % Particle starts at the origin
u = [0,0,1] % Particle is going down the positive z-axis
```

on a planar geometry consisting of 21 planes normal to the z-axis separated by 1 cm. That is, $z = 0, 1, 2, ...20$ cm.

Tally the average pathlength (and its error) that each particle takes in each planar zone for 10,000 incident particle histories.

Be careful with the tally. See below:

```
% Sample tally code
% Warning, transport with in a zone can contribite separate contributions to the pathlength
% path(1:Nr) accumulates the pathlength during each transport step for each zone
%        This has to be zeroed out before each history
% Path(1:Nr) captures the total path at the end of each history
Path  = Path  + path;
Path2 = Path2 + path.^2; % Need this to compute error bars
```

Once within the geometry, if it hits the plane at $z = 0$ or $z = 20$, it escapes.

```
% It would be most efficient to use the sample code called zplanesN.m
% All of the geometry coding is there for you
```

Plot both the results for isotropic and forward scattering. Compare and explain the results. Hand in only your plot(s), your main script M-file and associated discussion. You will need the library codes

```
rotate.m
azimuthal.m
zplane.m
```

Don't hand those in. If you find a bug in any of them, contact me ASAP.