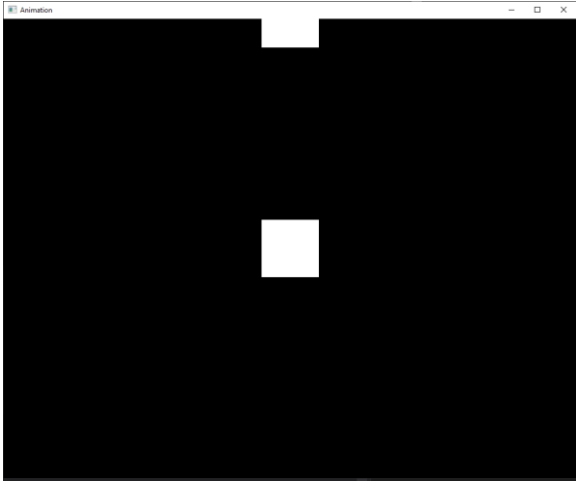


## Log Book

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Student ID: 20125059

Time Spent	Date	To do	Work Done	Detail	Bugs
0.5 hours	14/03		Created template.	Created template with main, init, idle, keyPressed and think class	
1 hours	15/03	Display a basic window	<ul style="list-style-type: none"><li>- Get a basic window displayed.</li><li>- Render basic shapes.</li><li>- Try to get transparency working.</li></ul>	<ul style="list-style-type: none"><li>- Playing around with basic shapes</li><li>- Setting up logics to get basic template working</li></ul>  <p>-</p>	Transparency not working

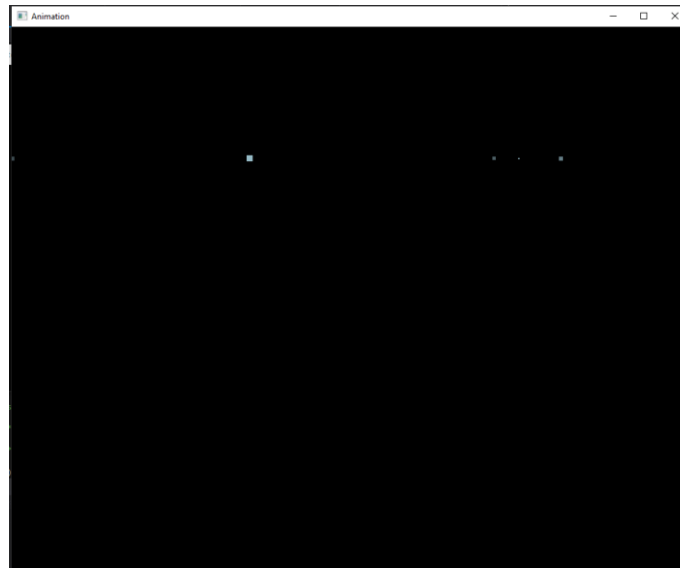
1 hours	18/03		<ul style="list-style-type: none"> <li>- Try to get animation working</li> </ul>	<ul style="list-style-type: none"> <li>- Attempted to get animation working but couldn't due to unknown compile exception</li> <li>- Structs for Vec2f, Vec3f and Particle_t implemented</li> </ul> <pre> void think(void) {     for (int i = 0; i &lt; sizeof(particleSystem); i++)     {         //particleSystem[i].position.y += particleSystem[i].velocity;         //if (particleSystem[i].position.y &lt; 1)         //{             // particleSystem[i].isActive = 0;         //}     } } </pre>	-
1 hours	18/03	Basic snow animation	<ul style="list-style-type: none"> <li>- Implemented basic 5 particle snow animation</li> </ul>	<ul style="list-style-type: none"> <li>- Fixed the unknown exception</li> <li>- Exception was due to index error sizeof(particleSystem) reached over the array length since size sizeof calculates sizeof bytes, not array length.</li> </ul> <pre> for (unsigned int i = 0; i &lt; sizeof(particleSystem) / sizeof(particleSystem[0]); i++) { </pre> <p>This solved the issue.</p> <ul style="list-style-type: none"> <li>- Added blending functions to able alpha channels for transparency</li> </ul> <pre> glEnable(GL_BLEND); glBlendFunc(GL_SRC_ALPHA, GL_ONE_MINUS_SRC_ALPHA); </pre> <p>This fixed the previous bugs with transparency.</p>	<p>MAX_PARTICLE has a lint when initialising with particleSystem array.</p>

Error when particleSystem array was initialised with MAX\_PARTICLE so fixed int of 5 is used till I find out why that has errors.

```
#define MAX_PARTICLES = 1000
```

```
Particle_t particleSystem[MAX_PARTICLES];
```

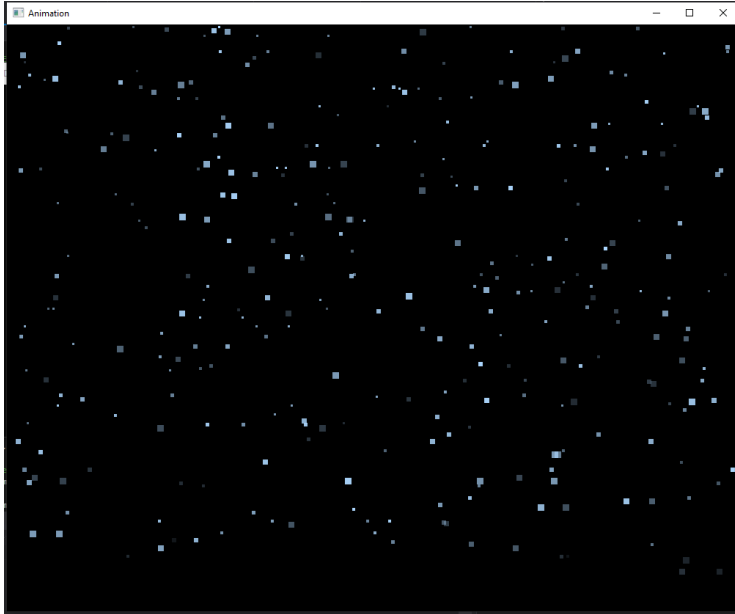
Image of working particle snow.

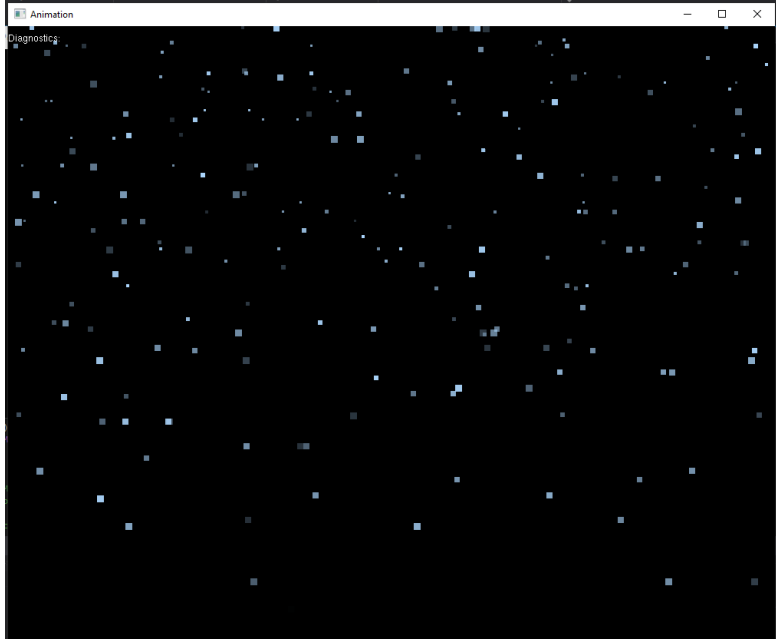
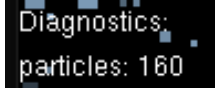


Position, size, transparency randomised.

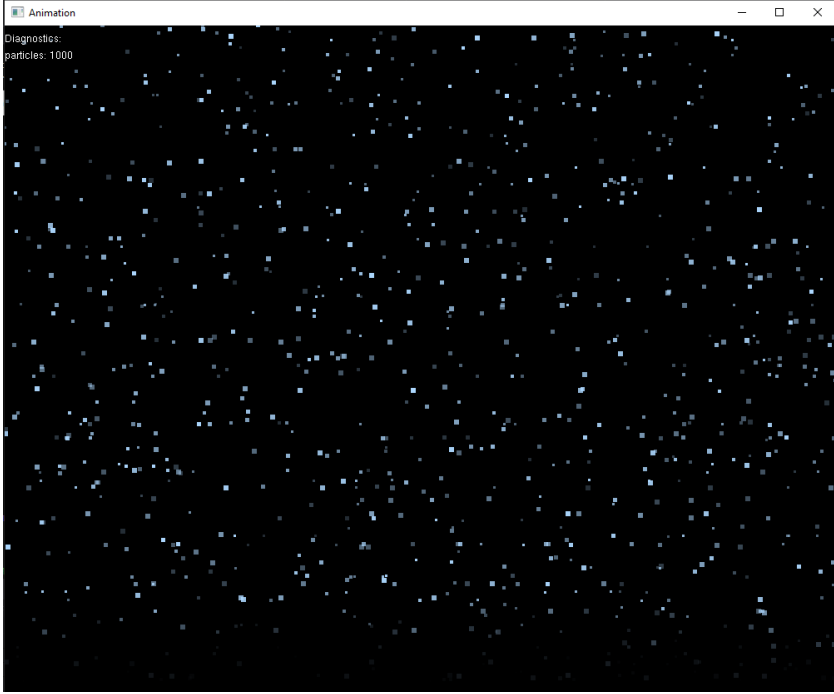
RandomFloat function added for returning a random range of float returned.

3 hours	18/03	<ul style="list-style-type: none"> <li>- Snow particle animation fully implemented</li> </ul>	<ul style="list-style-type: none"> <li>- 1000 particles working.</li> <li>- Simple wind effect.</li> <li>- Keyboard interaction.</li> <li>- Snow gravity.</li> <li>- Spawning at interval.</li> </ul>	<p>Max snow particle size of 1000. Still uses fixed int at particle system.</p> <p>Simple wind effect to the left.</p> <p>When pressing 's' particle will gradually spawn in. When pressed 's' again particles when deactivate slowly.</p> <p>Every 10 frames 10 particles will spawn in.</p> <p>Simulated snow gravity by dividing the snow size by a 1000.</p> <p>Particle will gradually decrease transparency at <math>x=-0.75f</math> and fully deactivate at <math>x=0.9f</math> or <math>y=1</math>.</p> <p>Will minus 0.05f transparency every time think is run if particle below <math>x=0.75f</math>.</p>	
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0.5 hour	18/03		<ul style="list-style-type: none"> <li>- Attempt to make bitmap text</li> </ul>	<p>Tried to do string concatenation and convert int to string but errors arrived.</p> <p>Added basic bitmap text for now</p> 	Error when using strcat and itoa.
1 hour	20/08		<ul style="list-style-type: none"> <li>- Fixed bitmap text error</li> <li>- Adjusted particles</li> </ul>	<p>Fixed error when using strcat and itoa by adding deprecated error ignore at the first line of code. <code>#define _CRT_SECURE_NO_WARNINGS</code></p> <p>Added amount of particle activated as bitmap text display</p> 	<ul style="list-style-type: none"> <li>- Particle recycle system not working as intended</li> </ul>


			<p><b>Adjustments to snow particle</b></p> <ul style="list-style-type: none"><li>- Split snow display</li></ul> <p>Split some snow to display behind and some to front (to be used in future).</p> <ul style="list-style-type: none"><li>- Wind effect features added</li></ul> <p>Pressing 'd' will toggle wind to 'left', 'right' or disabled.</p> <ul style="list-style-type: none"><li>- Shake effect added</li></ul> <p>Pressing 'a' will toggle shake snow 'on' or 'off'.</p> <ul style="list-style-type: none"><li>- Snow velocity changed</li></ul> <p>Changed so snows last longer on screen. (For debugging use. Be adjusted back later).</p> <ul style="list-style-type: none"><li>- Snow spawning adjusted</li></ul> <p>isActivated can be set to 1 or 2. 1 being spawned behind snowman and 2 for front.</p> <p>Spawns 16 snow particles per 10 frames. (For debugging use).</p> <ul style="list-style-type: none"><li>- Snow deactivation adjusted</li></ul> <p>Below <math>x=0.75f</math> transparency will decrease 5% at every think run. (1/60 seconds)</p> <ul style="list-style-type: none"><li>- Particle recycle</li></ul> <p>Pointer (array index) is used to keep in track of what particle to activate. Error after 1000 particles are spawned since some particles deactivates slower.</p> <p>When particle deactivates its position and transparency will be reset to randomise.</p> <p><b><i>I am more used to C and openGL now. Productivity has been increased!</i></b></p>	
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2 hours	27/03	- Recycle snow	- Fixed bug with snow recycles	<p>Deactivating and activating working.</p> <p>Max particle of 1000 is correctly working</p> <p>Used a while loop rather than for loop so every time a snow particle with isActive = 0 is switched to 1 or 2 would increment snowsSpawned with will always activate the right amoun of snow particles.</p> 	
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30 mins	27/03		- Finished diagnostics bitmap text	<div>Diagnostics: particles: 437 of 1000 Scene Controls: s: toggle snow a: toggle shake d: toggle wind q: quit</div>	
1 hour	27/03	-Added background  -Added snowman		<div>Animation</div> <div>Diagnostics: particles: 378 of 1000 Scene Controls: s: toggle snow a: toggle shake d: toggle wind q: quit</div>	



30 mins	27/03	-Basic snowman movement added		Snowman can be used by pressing down on pl;'. Tried to use arrow keys but did not work. Will fix in future. Scaling when moving backwards not implemented yet.	- Arrow key movement not working
10 mins	28/03		- Define bug fixed	<pre>#define MAX_PARTICLES 1000</pre> <p>Removed the equal's sign.</p> <p>Now it works as intended and MAX_PARTICLE is used for loop instead of calculating array size using sizeof().</p>	
30 mins	28/03		- Changed wind effect	Changed wind so it is stronger and more exponential.	
1 hour	29/03	- Snowman movement with arrow keys	- Fixed the bug with arrow keys not working	<p><b><i>With the help from the lecturer, these features were implemented</i></b></p> <pre>void keyReleased(unsigned char key, int x, int y); void specialKeyPressed(unsigned char key, int x, int y);</pre> <p>Added two more glut prototypes to handle arrow keys pressed down and up.</p> <pre>#define KEY_ARROW_UP 101 #define KEY_ARROW_DOWN 103 #define KEY_ARROW_RIGHT 102 #define KEY_ARROW_LEFT 100</pre> <p>ASCII keys for the arrow keys defined</p>	

4 hours		<ul style="list-style-type: none"><li>- Star particles added</li></ul>	<div data-bbox="855 193 1473 837"><p>Diagnostics: particles: 0 of 1000 Scene Controls: a: toggle shake s: toggle snow d: toggle wind e: toggle star q: quit</p></div> <p>Changed background to a black environment to simulate night-time. Also a sunset color on the floor added to give a spacious effect.</p> <p>Stars are made up of line from centre (origin) and draws out of centre with decreasing opacity.</p>	
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```


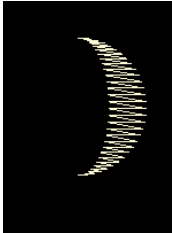
void drawStarLines(float x, float y, GLfloat theta, float scale, int angle, float lineSize, float transparency)
{
    glLineWidth(lineSize);
    glBegin(GL_LINES);
    {
        glColor4f(1, 1, 1, 0);
        glVertex2f((float)cos(DEG_TO_RAD * (theta + angle)) * scale + x,
            (float)sin(DEG_TO_RAD * (theta + angle)) * scale + y);
        glColor4f(1, 1, 1, transparency);
        glVertex2f(x, y);
    }
    glEnd();
}

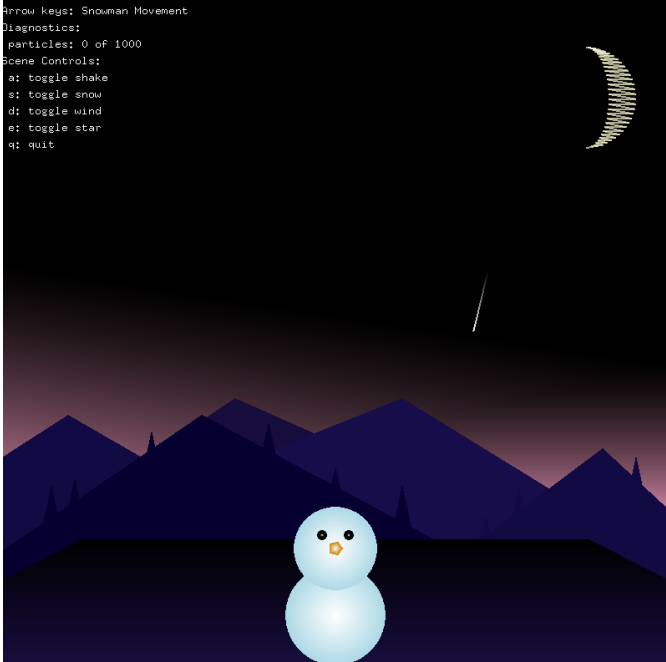
```

Helper function is made to draw many lines easily.

If the star effect is on the stars will turn on one by one looping through the starSystem array. When the stars are on, it will have a breath in and out effect with opacity changes and the scale will bounce in and out. When reaching below 0.1f opacity star will reset to a different location. While stars activated, when the user turns off the star effect the stars will gradually turn off like the snow. When star is toggled off and the star opacity reaches below 0.1f the star will no longer be displayed on the scene.

10 min		<ul style="list-style-type: none"><li>- Bitmap text for snowman control</li></ul>	<div><div>Diagnostics: particles: 0 of 1000 Scene Controls: a: toggle shake s: toggle snow d: toggle wind e: toggle star q: quit</div><div>Arrow keys: Snowman Movement</div><div></div></div> <p>Added final helper to know that users can control the snowman with the arrow keys on their keyboard.</p>	
1 hour		<ul style="list-style-type: none"><li>- Added snowman shrink</li><li>- Added moon</li></ul>	<p>Snowman now shrinks by 2% when moving up and down.</p> <pre>void moveSnowmanUp() {     if (snowman.position.y &gt; groundPosition.y - (1 - snowman.scale) - 0.005f) return;     snowman.scale *= 0.98f;     snowman.position.y += 0.01f; }</pre>	

				 <p>Moon added to the scene using a code from stackoverflow</p> <pre>void drawCrescentMoon(float x, float y, float step, float scale, float fullness) {     glColor3f(0.99f, 0.98f, 0.84f);     glBegin(GL_TRIANGLE_STRIP);     {         glVertex2f(x, scale + y);         float angle = step;         while (angle &lt; PI) {             float sinAngle = sinf(angle);             float cosAngle = cosf(angle);             glVertex2f(scale*sinAngle + x, scale*cosAngle + y);             glVertex2f(-fullness * scale*sinAngle + x, scale*cosAngle + y);             angle += step;         }         glVertex2f(x, -scale + y);     }     glEnd(); }</pre> <p>Modified code so it can be moved and change the scaling.</p> <p><a href="https://stackoverflow.com/questions/7260963/drawing-a-crescent-shape-in-opengl">https://stackoverflow.com/questions/7260963/drawing-a-crescent-shape-in-opengl</a></p>	
10 min		- Changed shape		<p>Changed the moon shape</p> 	

1 hour		<ul style="list-style-type: none"><li>- Added shooting star</li></ul>	<div><div><div>Animation</div><div>Arrow keys: Snowman Movement Diagnostics: particles: 0 of 1000 Scene Controls: a: toggle shake s: toggle snow d: toggle wind e: toggle star q: quit</div></div><p>Shooting star activates every 200 frames.</p><pre>// Activate shooting star every 500 frames if (frameCount % 500 == 0) {     if(shootingStar.isActive == 0)         shootingStar.isActive = 1; }</pre><p>If shooting star reaches out of the window it is deactivated and the positions will randomize for recycling.</p></div>	
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			<pre>typedef struct {     Vec2f lightPosition;     Vec2f darkPosition;     float lineWidth;     float velocity;     int isActive; } Particle_SS;</pre>	
			Struct called Particle_SS for shooting star.	