

Autonomous Steering Agents

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Chapter 1

Intent

- 1- implementing Craig Reynolds autonomous steering agents
- 2- implementing genetics algorithms
- 3- implementing neural network

1.1 Dependencies

```
$sudo apt-get install libglu1-mesa-dev freeglut3-dev mesa-common-dev
```

```
$sudo apt-get install libboost-all-dev
```

1.2 Resources

<https://natureofcode.com/book/chapter-6-autonomous-agents>

<https://gamedevelopment.tutsplus.com/series/understanding-steering-behaviors-gamedev-12>

<https://videotutorialsrock.com/index.php>

<https://www.opengl.org/resources/libraries/glut/spec3/node1.html>

<https://learnopengl.com/Getting-started/Coordinate-Systems>

Chapter 2

Hierarchical Index

2.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

agent	9
color	14
flowField	22
graphics	24
obstacle	32
path	36
point	40
pvector	47
random	53
scenario	54
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Chapter 3

Class Index

3.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

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flee	19
flock	20
flowField	22
graphics	24
mouseFollower	30
obstacle	32
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Chapter 4

File Index

4.1 File List

Here is a list of all files with brief descriptions:

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Color class used for agent, path, wall etc. color	67
include/evade.h	68
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include/flowField.h	
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test/ test_suites.cpp	85

Chapter 5

Class Documentation

5.1 agent Class Reference

```
#include <agent.h>
```

Collaboration diagram for agent:

Public Member Functions

- [agent](#) (float x, float y)
- [agent](#) ()
- [~agent](#) ()
- void [updatePosition](#) (bool [arrive](#))
- void [setFeatures](#) (float s, float f, float r, float m)

Public Attributes

- string [name](#)
- color [fillColor](#)
- point [position](#)
- pvector [velocity](#)
- point [targetPoint](#)
- float [maxSpeed](#)
- float [maxForce](#)
- pvector [steering](#)
- pvector [force](#)
- pvector [acceleration](#)
- pvector [desiredVelocity](#)
- float [r](#)
- float [mass](#)
- int [id](#)
- bool [arrive](#) = false

5.1.1 Detailed Description

Definition at line 18 of file agent.h.

5.1.2 Constructor & Destructor Documentation

5.1.2.1 agent() [1/2]

```
agent::agent (
    float x,
    float y )
```

Definition at line 11 of file agent.cpp.

```
11     {
12         position      = point(x, y);
13         velocity       = pvector(0.6, 0.0);
14         acceleration   = pvector(0.0, 0.0);
15         steering       = pvector(0.0, 0.0);
16         desiredVelocity = pvector(0.0, 0.0);
17         force          = pvector(0.0, 0.0);
18         targetPoint    = point(0.0, 0.0);
19         fillColor      = color(1.0, 0.0, 0.0);
20     }
```

5.1.2.2 agent() [2/2]

```
agent::agent ( )
```

Definition at line 9 of file agent.cpp.

```
9 {}
```

5.1.2.3 ~agent()

```
agent::~agent ( )
```

Definition at line 49 of file agent.cpp.

```
49 {}
```

5.1.3 Member Function Documentation

5.1.3.1 setFeatures()

```
void agent::setFeatures (
    float s,
    float f,
    float r,
    float m )
```

Definition at line 42 of file agent.cpp.

```
42     {
43         this->maxSpeed = s;
44         this->maxForce = f;
45         this->r = r;
46         this->mass = m;
47     }
```

5.1.3.2 updatePosition()

```
void agent::updatePosition (
    bool arrive )
```

Definition at line 22 of file agent.cpp.

```
22 {
23     force.limit(maxForce);
24     acceleration = force;
25     velocity += acceleration;
26
27     //arriving behavior implementation
28     if(arrive == true){
29         pvector diff = targetPoint - position;
30         if(diff.magnitude() > r)
31             velocity.limit(maxSpeed);
32         else
33             velocity.limit(maxSpeed * diff.magnitude() / r);
34     }
35     else
36         velocity.limit(maxSpeed);
37
38     position = position + velocity;
39     force = pvector(0,0);
40 }
```

Here is the call graph for this function:

5.1.4 Member Data Documentation

5.1.4.1 acceleration

```
pvector agent::acceleration
```

Definition at line 34 of file agent.h.

5.1.4.2 arrive

```
bool agent::arrive = false
```

Definition at line 39 of file agent.h.

5.1.4.3 desiredVelocity

```
pvector agent::desiredVelocity
```

Definition at line 35 of file agent.h.

5.1.4.4 fillColor

```
color agent::fillColor
```

Definition at line 26 of file agent.h.

5.1.4.5 force

```
pvector agent::force
```

Definition at line 33 of file agent.h.

5.1.4.6 id

```
int agent::id
```

Definition at line 38 of file agent.h.

5.1.4.7 mass

```
float agent::mass
```

Definition at line 37 of file agent.h.

5.1.4.8 maxForce

```
float agent::maxForce
```

Definition at line 31 of file agent.h.

5.1.4.9 maxSpeed

```
float agent::maxSpeed
```

Definition at line 30 of file agent.h.

5.1.4.10 name

```
string agent::name
```

Definition at line 25 of file agent.h.

5.1.4.11 position

```
point agent::position
```

Definition at line 27 of file agent.h.

5.1.4.12 r

```
float agent::r
```

Definition at line 36 of file agent.h.

5.1.4.13 steering

```
pvector agent::steering
```

Definition at line 32 of file agent.h.

5.1.4.14 targetPoint

```
point agent::targetPoint
```

Definition at line 29 of file agent.h.

5.1.4.15 velocity

```
pvector agent::velocity
```

Definition at line 28 of file agent.h.

The documentation for this class was generated from the following files:

- [include/agent.h](#)
- [src/agent.cpp](#)

5.2 color Class Reference

```
#include <color.h>
```

Collaboration diagram for color:

Public Member Functions

- [color](#) ()
default constructor.
- [color](#) (float r, float g, float b)
Constructor.
- void [createColors](#) ()
fills colors vector with 8 main colors in color bar
- [color](#) [getColor](#) (int i)
Constructor.

Public Attributes

- float [R](#)
red condiment
- float [G](#)
green condiment
- float [B](#)
blue condiment
- vector< [color](#) > [colors](#)
stores main colors

5.2.1 Detailed Description

Definition at line 20 of file color.h.

5.2.2 Constructor & Destructor Documentation

5.2.2.1 [color](#)() [1/2]

```
color::color ( )
```

default constructor.

Create a new color object.

See also

[color\(float r, float g, float b\)](#)

Definition at line 25 of file color.cpp.

```
26 {  
27  
28 }
```

5.2.2.2 color() [2/2]

```
color::color (
    float r,
    float g,
    float b )
```

Constructor.

Create a new color object.

Parameters

<i>r</i>	red (0-255)
<i>g</i>	green (0-255)
<i>b</i>	blue (0-255)

See also

[path\(\)](#)

Definition at line 13 of file color.cpp.

```
14 {
15     R = r;
16     G = g;
17     B = b;
18 }
```

5.2.3 Member Function Documentation

5.2.3.1 createColors()

```
void color::createColors ( )
```

fills colors vector with 8 main colors in color bar

creates main colors for future use

Definition at line 30 of file color.cpp.

```
31 {
32     colors.push_back(color(0.0, 0.0, 0.0));
33     colors.push_back(color(0.0, 0.0, 1.0));
34     colors.push_back(color(0.0, 1.0, 0.0));
35     colors.push_back(color(0.0, 1.0, 1.0));
36     colors.push_back(color(1.0, 0.0, 0.0));
37     colors.push_back(color(1.0, 0.0, 1.0));
38     colors.push_back(color(1.0, 1.0, 0.0));
39     colors.push_back(color(1.0, 1.0, 1.0));
40 }
```

5.2.3.2 getColor()

```
color color::getColor (
    int i )
```

Constructor.

returns specified color from colors vector

Parameters

<i>i</i>	gets specified color
----------	----------------------

Returns

requested pre-created color instance

Definition at line 20 of file color.cpp.

```
21 {  
22     return colors.at(i);  
23 }
```

Here is the caller graph for this function:

5.2.4 Member Data Documentation

5.2.4.1 B

```
float color::B
```

blue condiment

blue color ratio

Definition at line 69 of file color.h.

5.2.4.2 colors

```
vector<color> color::colors
```

stores main colors

vector of fundamental colors

Definition at line 75 of file color.h.

5.2.4.3 G

```
float color::G
```

green condiment

green color ratio

Definition at line 63 of file color.h.

5.2.4.4 R

```
float color::R
```

red condiment

red color ratio

Definition at line 57 of file color.h.

The documentation for this class was generated from the following files:

- include/[color.h](#)
- src/[color.cpp](#)

5.3 evade Class Reference

```
#include <evade.h>
```

Inheritance diagram for evade:

Collaboration diagram for evade:

Public Member Functions

- [evade](#) ()
- void [initGL](#) (int *argc, char **argv) override

Static Public Member Functions

- static void [loop](#) ()

Additional Inherited Members

5.3.1 Detailed Description

Definition at line 8 of file evade.h.

5.3.2 Constructor & Destructor Documentation

5.3.2.1 evade()

```
evade::evade ( )
```

Definition at line 29 of file evade.cpp.

```
29     {
30         name = "evading";
31         createAgent(STATIC, 0, 0, 0);
32     }
```

5.3.3 Member Function Documentation

5.3.3.1 initGL()

```
void evade::initGL (
    int * argc,
    char ** argv ) [override], [virtual]
```

Implements [scenario](#).

Definition at line 8 of file evade.cpp.

```
8     {
9         void(* callback)();
10        callback = reinterpret_cast<void(*)()> ( (void *)(&loop) );
11        view.initGraphics(argc, argv, callback);
12    }
```

Here is the caller graph for this function:

5.3.3.2 loop()

```
void evade::loop ( ) [static]
```

Definition at line 14 of file evade.cpp.

```
14     {
15         for(auto it = agents.begin(); it < agents.end(); it++){
16             if((*it).name == "lion"){
17                 (*it).targetPoint = view.getMousePosition();
18                 (*it).force = behavior.seek(*it);
19                 (*it).arrive = true;
20             }
21             else{//gazelle
22                 (*it).force = behavior.evade(agents, *it, view);
23             }
24         }
25
26         refresh();
27     }
```

The documentation for this class was generated from the following files:

- [include/evade.h](#)
- [src/evade.cpp](#)

5.4 flee Class Reference

```
#include <flee.h>
```

Inheritance diagram for flee:

Collaboration diagram for flee:

Public Member Functions

- `flee()`
- `void initGL (int *argc, char **argv) override`

Static Public Member Functions

- `static void loop ()`

Additional Inherited Members

5.4.1 Detailed Description

Definition at line 8 of file flee.h.

5.4.2 Constructor & Destructor Documentation

5.4.2.1 flee()

```
flee::flee ( )
```

Definition at line 22 of file flee.cpp.

```
22     {  
23         name = "fleeing troop";  
24         createAgent(TROOP, 196, 0, 0);  
25     }
```

5.4.3 Member Function Documentation

5.4.3.1 initGL()

```
void flee::initGL (
    int * argc,
    char ** argv ) [override], [virtual]
```

Implements [scenario](#).

Definition at line 8 of file flee.cpp.

```
8      {
9      void(* callback)();
10     callback = reinterpret_cast <void(*)()> ( (void *)(&loop) );
11     view.initGraphics(argc, argv, callback);
12 }
```

Here is the caller graph for this function:

5.4.3.2 loop()

```
void flee::loop ( ) [static]
```

Definition at line 14 of file flee.cpp.

```
14     {
15     for(auto it = agents.begin(); it < agents.end(); it++){
16         (*it).force = behavior.flee((*it), view, view.getMousePosition());
17     }
18
19     refresh();
20 }
```

The documentation for this class was generated from the following files:

- [include/flee.h](#)
- [src/flee.cpp](#)

5.5 flock Class Reference

```
#include <flock.h>
```

Inheritance diagram for flock:

Collaboration diagram for flock:

Public Member Functions

- [flock](#) ()
- void [initGL](#) (int *argc, char **argv) override

Static Public Member Functions

- static void [loop](#) ()

Additional Inherited Members

5.5.1 Detailed Description

Definition at line 8 of file flock.h.

5.5.2 Constructor & Destructor Documentation

5.5.2.1 flock()

```
flock::flock ( )
```

Definition at line 34 of file flock.cpp.

```
34     {
35         name = "flocking agents";
36         createAgent(RANDOM, 50, 0.3, 1);
37     }
```

5.5.3 Member Function Documentation

5.5.3.1 initGL()

```
void flock::initGL (
    int * argc,
    char ** argv ) [override], [virtual]
```

Implements [scenario](#).

Definition at line 8 of file flock.cpp.

```
8     {
9         void(* callback)();
10        callback = reinterpret_cast<void(*)()> ( (void *)(&loop) );
11        view.initGraphics(argc, argv, callback);
12    }
```

Here is the caller graph for this function:

5.5.3.2 loop()

```
void flock::loop ( ) [static]
```

Definition at line 14 of file flock.cpp.

```
14      {
15      for(auto it = agents.begin(); it < agents.end(); it++){
16          view.forceInScreen((*it));
17
18          pvector sep = behavior.separation(agents, *it);
19          sep.mul(1.5);
20          pvector ali = behavior.align(agents, *it);
21          ali.mul(4);
22          pvector coh = behavior.cohesion(agents, *it);
23          coh.mul(0.1);
24
25          (*it).force = sep + ali + coh;
26          (*it).desiredVelocity = (*it).force + (*it).velocity;
27          (*it).targetPoint = (*it).position + (*it).desiredVelocity;
28          (*it).arrive = true;
29      }
30
31      refresh();
32  }
```

Here is the call graph for this function:

The documentation for this class was generated from the following files:

- [include/flock.h](#)
- [src/flock.cpp](#)

5.6 flowField Class Reference

```
#include <flowField.h>
```

Collaboration diagram for flowField:

Public Member Functions

- [flowField \(\)](#)
default constructor.
- [flowField \(pvector p\)](#)
constructor.
- [pvector getField \(int x, int y\)](#)
get force for individual pixel

5.6.1 Detailed Description

Definition at line 18 of file flowField.h.

5.6.2 Constructor & Destructor Documentation

5.6.2.1 flowField() [1/2]

```
flowField::flowField ( )
```

default constructor.

Create a new [flowField](#) object.

See also

[flowField\(pvector p\)](#)

Definition at line 15 of file flowField.cpp.

```
15 {}
```

5.6.2.2 flowField() [2/2]

```
flowField::flowField (
    pvector p )
```

constructor.

Create a new [flowField](#) object.

Parameters

<i>p</i>	force vector
----------	--------------

See also

[flowField\(\)](#)

Definition at line 10 of file flowField.cpp.

```
11 {
12     createFlowField(p);
13 }
```

5.6.3 Member Function Documentation**5.6.3.1 getField()**

```
pvector flowField::getField (
    int x,
    int y )
```

get force for individual pixel

get force for a specific position

Parameters

<i>x</i>	x cprovidescoordinate
<i>y</i>	y coordinate

Returns

returns force at specified position

Definition at line 36 of file flowField.cpp.

```
37 {
38     return uniformField[x][y];
39 }
```

Here is the caller graph for this function:

The documentation for this class was generated from the following files:

- [include/flowField.h](#)
- [src/flowField.cpp](#)

5.7 graphics Class Reference

```
#include <graphics.h>
```

Collaboration diagram for graphics:

Public Member Functions

- void [drawWall](#) (float border, [color](#) color)
- void [drawAgent](#) ([agent](#) &agent, [color](#) &color)
- void [drawLine](#) ([point](#) p1, [point](#) p2, [color](#) cl)
- void [drawPath](#) ([path](#) &path, [color](#) color)
- void [drawPoint](#) ([point](#) p)
- void [drawCircle](#) ([point](#) p, float radius)
- void [drawText](#) (string text, [point](#) p)
- void [forceInScreen](#) ([agent](#) &agent)
- void [refreshScene](#) ()
- [point](#) [getMousePosition](#) ()
- void [initGraphics](#) (int *argv, char **argc, void(*callback)())

Static Public Member Functions

- static void [timerEvent](#) (int value)
- static void [handleKeypress](#) (unsigned char key, int x, int y)
- static void [mouseButton](#) (int button, int state, int x, int y)
- static void [handleResize](#) (int w, int h)
- static void [mouseMove](#) (int x, int y)

Static Public Attributes

- static int `target_x` = `-WIDTH`
- static int `target_y` = `HEIGHT`

5.7.1 Detailed Description

Definition at line 15 of file `graphics.h`.

5.7.2 Member Function Documentation

5.7.2.1 `drawAgent()`

```
void graphics::drawAgent (
    agent & agent,
    color & color )
```

Definition at line 162 of file `graphics.cpp`.

```
162 {
163     glPushMatrix();
164     glTranslatef(agent.position.x, agent.position.y, 0.0f);
165     glRotatef(agent.velocity.getAngle(), 0.0f, 0.0f, 1.0f);
166     glBegin(GL_TRIANGLES);
167     glColor3f( color.R, color.G, color.B);
168     glVertex3f( 1.0f, 0.0f, 0.0f);
169     glVertex3f(-1.0f, 0.5f, 0.0f);
170     glVertex3f(-1.0f, -0.5f, 0.0f);
171     glEnd();
172     glPopMatrix();
173 }
```

Here is the call graph for this function:

5.7.2.2 `drawCircle()`

```
void graphics::drawCircle (
    point p,
    float radius )
```

Definition at line 124 of file `graphics.cpp`.

```
124 {
125     glBegin(GL_LINE_STRIP);
126     glLineWidth(2);
127     for (int i = 0; i <= 300; i++) {
128         float angle = 2 * PI * i / 300;
129         float x = cos(angle) * radius;
130         float y = sin(angle) * radius;
131         glVertex2d(p.x + x, p.y + y);
132     }
133     glEnd();
134 }
```

5.7.2.3 drawLine()

```
void graphics::drawLine (
    point p1,
    point p2,
    color cl )
```

Definition at line 115 of file graphics.cpp.

```
115                                     {
116     glColor3f( cl.R, cl.G, cl.B);
117     glLineWidth(2);
118     glBegin(GL_LINES);
119     glVertex2f(p1.x, p1.y);
120     glVertex2f(p2.x, p2.y);
121     glEnd();
122 }
```

5.7.2.4 drawPath()

```
void graphics::drawPath (
    path & path,
    color color )
```

Definition at line 102 of file graphics.cpp.

```
102                                     {
103     point p1, p2;
104     for(auto it = path.points.begin(); it < path.points.end()-1; it++){
105         p1 = point((*it).x, (*it).y - path.width/2) ;
106         p2 = point((*it+1).x, (*it+1).y - path.width/2);
107         drawLine(p1, p2, color.getColor(BLUE));
108     }
109     p1 = point((*it).x, (*it).y + path.width/2) ;
110     p2 = point((*it+1).x, (*it+1).y + path.width/2);
111     drawLine(p1, p2, color.getColor(BLUE));
112 }
113 }
```

Here is the call graph for this function:

5.7.2.5 drawPoint()

```
void graphics::drawPoint (
    point p )
```

Definition at line 136 of file graphics.cpp.

```
136                                     {
137     glColor3f(1,1,1);
138     glPointSize(4.0);
139     glBegin(GL_POINTS);
140     glVertex2f(p.x, p.y);
141     glEnd();
142 }
```

Here is the caller graph for this function:

5.7.2.6 drawText()

```
void graphics::drawText (
    string text,
    point p )
```

Definition at line 14 of file graphics.cpp.

```
14 {
15     glColor3f (0.0, 0.0, 1.0);
16     //glRasterPos2f(-34, 32.5);
17     glRasterPos2f(p.x, p.y);
18     for ( string::iterator it=text.begin(); it!=text.end(); ++it){
19         glutBitmapCharacter(GLUT_BITMAP_9_BY_15, *it);
20     }
21 }
```

Here is the caller graph for this function:

5.7.2.7 drawWall()

```
void graphics::drawWall (
    float border,
    color color )
```

Definition at line 144 of file graphics.cpp.

```
144 {
145     point p1 {-border, border};
146     point p2 { border, border};
147     drawLine(p1, p2, color.getColor(BLUE));
148
149     p1 = point ( border, border);
150     p2 = point ( border, -border);
151     drawLine(p1, p2, color.getColor(BLUE));
152
153     p1 = point ( border, -border);
154     p2 = point ( -border, -border);
155     drawLine(p1, p2, color.getColor(BLUE));
156
157     p1 = point (-border, border);
158     p2 = point (-border, -border);
159     drawLine(p1, p2, color.getColor(BLUE));
160 }
```

Here is the call graph for this function:

5.7.2.8 forceInScreen()

```
void graphics::forceInScreen (
    agent & agent )
```

Definition at line 52 of file graphics.cpp.

```
52 {
53     if(agent.position.x > WIDTH)
54         agent.position.x -= 2 * WIDTH;
55     if(agent.position.x < -WIDTH)
56         agent.position.x += 2 * WIDTH;
57     if(agent.position.y > HEIGHT)
58         agent.position.y -= 2 * HEIGHT;
59     if(agent.position.y < -HEIGHT)
60         agent.position.y += 2 * HEIGHT;
61 }
```

5.7.2.9 getMousePosition()

```
point graphics::getMousePosition ( )
```

Definition at line 48 of file graphics.cpp.

```
48     {
49     return point (graphics::target_x, graphics::target_y);
50 }
```

Here is the call graph for this function:

5.7.2.10 handleKeypress()

```
void graphics::handleKeypress (
    unsigned char key,
    int x,
    int y ) [static]
```

Definition at line 99 of file graphics.cpp.

```
99     {
100     if (key == ESC){ exit(0); }
101 }
```

Here is the caller graph for this function:

5.7.2.11 handleResize()

```
void graphics::handleResize (
    int w,
    int h ) [static]
```

Definition at line 70 of file graphics.cpp.

```
70     {
71     glViewport(0, 0, w, h); //Tell OpenGL how to convert from coordinates to pixel values
72     glMatrixMode(GL_PROJECTION); //Switch to setting the camera perspective
73     glLoadIdentity(); //Reset the camera
74     //Set the camera perspective
75     gluPerspective(45.0, //The camera angle
76     (double)w / (double)h, //The width-to-height ratio
77     1.0, //The near z clipping coordinate
78     200.0); //The far z clipping coordinate
79 }
```

Here is the caller graph for this function:

5.7.2.12 initGraphics()

```
void graphics::initGraphics (
    int * argv,
    char ** argc,
    void(*)() callback )
```

Definition at line 32 of file graphics.cpp.

```
32     {
33     glutInit(argv, argc);
34     glutInitDisplayMode(GLUT_DOUBLE | GLUT_RGB | GLUT_DEPTH);
35     glutInitWindowSize(400, 400);
36     glutCreateWindow("Autonomous Steering Agents");
37     glClearColor(0.7f, 0.7f, 0.7f, 1.0f); //set background color
38     glEnable(GL_DEPTH_TEST);
39     glutDisplayFunc(*callback);
40     glutMouseFunc(graphics::mouseButton);
41     glutPassiveMotionFunc(graphics::mouseMove);
42     glutKeyboardFunc(graphics::handleKeypress);
43     glutReshapeFunc(graphics::handleResize);
44     glutTimerFunc(5, graphics::timerEvent, 0);
45     glutMainLoop();
46 }
```

Here is the call graph for this function:

5.7.2.13 mouseButton()

```
void graphics::mouseButton (
    int button,
    int state,
    int x,
    int y ) [static]
```

Definition at line 93 of file graphics.cpp.

```
93 {
94     if (button == GLUT_LEFT_BUTTON && state == GLUT_DOWN) {
95         cout << "zdf";
96     }
97 }
```

Here is the caller graph for this function:

5.7.2.14 mouseMove()

```
void graphics::mouseMove (
    int x,
    int y ) [static]
```

Definition at line 63 of file graphics.cpp.

```
63 {
64     //TODO: mouse position to glut
65     //TODO: magic numbers
66     graphics::target_x = x / 5.88 - 34;
67     graphics::target_y = 34 - y / 5.88;
68 }
```

Here is the caller graph for this function:

5.7.2.15 refreshScene()

```
void graphics::refreshScene ( )
```

Definition at line 24 of file graphics.cpp.

```
24 {
25     glutSwapBuffers();
26     glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
27     glMatrixMode(GL_MODELVIEW); //Switch to the drawing perspective
28     glLoadIdentity(); //Reset the drawing perspective
29     glTranslatef(0.0f, 0.0f, -85.0f); //Move to the center of the triangle
30 }
```

5.7.2.16 timerEvent()

```
void graphics::timerEvent (
    int value ) [static]
```

Definition at line 83 of file graphics.cpp.

```
83 {
84     glutPostRedisplay(); //Tell GLUT that the display has changed
85     glutTimerFunc(20, timerEvent, 0);
86     /*counter++;
87     if(counter == _100_MS * 2){
88         counter = 0;
89         graphics::timerEventFlag = true;
90     }*/
91 }
```

Here is the caller graph for this function:

5.7.3 Member Data Documentation

5.7.3.1 target_x

```
int graphics::target_x = -WIDTH [static]
```

Definition at line 33 of file graphics.h.

5.7.3.2 target_y

```
int graphics::target_y = HEIGHT [static]
```

Definition at line 34 of file graphics.h.

The documentation for this class was generated from the following files:

- [include/graphics.h](#)
- [src/graphics.cpp](#)

5.8 mouseFollower Class Reference

```
#include <mouseFollower.h>
```

Inheritance diagram for mouseFollower:

Collaboration diagram for mouseFollower:

Public Member Functions

- [mouseFollower](#) ()
- void [initGL](#) (int *argc, char **argv) override

Static Public Member Functions

- static void [loop](#) ()

Additional Inherited Members

5.8.1 Detailed Description

Definition at line 8 of file mouseFollower.h.

5.8.2 Constructor & Destructor Documentation

5.8.2.1 mouseFollower()

```
mouseFollower::mouseFollower ( )
```

Definition at line 24 of file mouseFollower.cpp.

```
24 {
25     name = "mouse following";
26     createAgent(RANDOM, 30, 0.3, 0.6);
27 }
```

5.8.3 Member Function Documentation

5.8.3.1 initGL()

```
void mouseFollower::initGL (
    int * argc,
    char ** argv ) [override], [virtual]
```

Implements [scenario](#).

Definition at line 8 of file mouseFollower.cpp.

```
8 {
9     void(* callback)();
10    callback = reinterpret_cast <void(*)()> ( (void *)(&loop) );
11    view.initGraphics(argc, argv, callback);
12 }
```

Here is the caller graph for this function:

5.8.3.2 loop()

```
void mouseFollower::loop ( ) [static]
```

Definition at line 14 of file mouseFollower.cpp.

```
14 {
15     for(auto it = agents.begin(); it < agents.end(); it++){
16         (*it).targetPoint = view.getMousePosition();
17         (*it).force = behavior.seek(*it);
18         (*it).arrive = true;
19     }
20
21     refresh();
22 }
```

The documentation for this class was generated from the following files:

- include/mouseFollower.h
- src/mouseFollower.cpp

5.9 obstacle Class Reference

```
#include <obstacle.h>
```

Collaboration diagram for obstacle:

Public Member Functions

- [obstacle](#) ()
Default constructor.
- [obstacle](#) ([point](#) p, float r)
Constructor.

Public Attributes

- [point](#) p
x and y coordinates
- float r
the bigger radius the bigger the obstacle

5.9.1 Detailed Description

Definition at line 12 of file obstacle.h.

5.9.2 Constructor & Destructor Documentation

5.9.2.1 obstacle() [1/2]

```
obstacle::obstacle ( )
```

Default constructor.

Create a new obstacle object.

See also

[obstacle\(point p, float r\);](#)

Definition at line 15 of file obstacle.cpp.
15 {}

5.9.2.2 obstacle() [2/2]

```
obstacle::obstacle (
    point p,
    float r )
```

Constructor.

Create a new obstacle object.

Parameters

p	center of the circular obstacle
r	radius of the obstacle

See also

[obstacle\(point p, float r\);](#)

Definition at line 17 of file obstacle.cpp.

```
17 {  
18     this->p = p;  
19     this->r = r;  
20 }
```

5.9.3 Member Data Documentation

5.9.3.1 p

`point` `obstacle::p`

x and y coordinates

center point of the obstacle

Definition at line 34 of file obstacle.h.

5.9.3.2 r

`float` `obstacle::r`

the bigger radius the bigger the obstacle

radius of the obstacle

Definition at line 40 of file obstacle.h.

The documentation for this class was generated from the following files:

- [include/obstacle.h](#)
- [src/obstacle.cpp](#)

5.10 obstacleAvoidance Class Reference

```
#include <obstacleAvoidance.h>
```

Inheritance diagram for obstacleAvoidance:

Collaboration diagram for obstacleAvoidance:

Public Member Functions

- [obstacleAvoidance](#) ()
- void [initGL](#) (int *argc, char **argv) override

Static Public Member Functions

- static void [loop](#) ()
- static void [createObstacle](#) (vector< [obstacle](#) > &[obstacles](#))

Static Public Attributes

- static vector< [obstacle](#) > [obstacles](#)

5.10.1 Detailed Description

Definition at line 9 of file obstacleAvoidance.h.

5.10.2 Constructor & Destructor Documentation

5.10.2.1 obstacleAvoidance()

```
obstacleAvoidance::obstacleAvoidance ( )
```

Definition at line 40 of file obstacleAvoidance.cpp.

```
40         {
41     name = "avoid obstacles";
42     createAgent(STATIC, 0, 0, 0);
43     createObstacle(obstacles);
44 }
```

5.10.3 Member Function Documentation

5.10.3.1 createObstacle()

```
void obstacleAvoidance::createObstacle (
    vector< obstacle > & obstacles ) [static]
```

Definition at line 34 of file obstacleAvoidance.cpp.

```
34 {
35     obstacles.push_back(obstacle(point(0,0), 8));
36     obstacles.push_back(obstacle(point(-20,0), 3));
37     obstacles.push_back(obstacle(point(20,-10), 4));
38 }
```

Here is the call graph for this function:

5.10.3.2 initGL()

```
void obstacleAvoidance::initGL (
    int * argc,
    char ** argv ) [override], [virtual]
```

Implements [scenario](#).

Definition at line 10 of file obstacleAvoidance.cpp.

```
10 {
11     void(* callback) ();
12     callback = reinterpret_cast <void(*)()> ( (void *)(&loop) );
13     view.initGraphics(argc, argv, callback);
14 }
```

Here is the caller graph for this function:

5.10.3.3 loop()

```
void obstacleAvoidance::loop ( ) [static]
```

Definition at line 16 of file obstacleAvoidance.cpp.

```
16 {
17     for(auto it = agents.begin(); it < agents.end(); it++){
18         for(auto it = obstacles.begin(); it < obstacles.end(); it++){
19             point p = (*it).p;
20             view.drawCircle(p, (*it).r);
21         }
22     }
23     (*it).targetPoint = view.getMousePosition();
24     pvector seek = behavior.seek(*it);
25     seek.mul(0.5);
26
27     pvector avoid = behavior.avoid(obstacles, *it);
28     (*it).force = avoid + seek;
29     (*it).arrive = true;
30 }
31 refresh();
32 }
```

Here is the call graph for this function:

5.10.4 Member Data Documentation

5.10.4.1 obstacles

```
vector< obstacle > obstacleAvoidance::obstacles [static]
```

Definition at line 13 of file obstacleAvoidance.h.

The documentation for this class was generated from the following files:

- include/[obstacleAvoidance.h](#)
- src/[obstacleAvoidance.cpp](#)

5.11 path Class Reference

```
#include <path.h>
```

Collaboration diagram for path:

Public Member Functions

- [path](#) ()
Default constructor.
- [path](#) (float [width](#))
Constructor.
- void [addPoint](#) ([point](#) p)
adds a new point to the path

Public Attributes

- vector< [point](#) > [points](#)
points added to the path
- int [width](#)
defines width of the path

5.11.1 Detailed Description

Definition at line 15 of file path.h.

5.11.2 Constructor & Destructor Documentation

5.11.2.1 path() [1/2]

```
path::path ( )
```

Default constructor.

Create a new path object.

See also

[path\(float width\)](#)

Definition at line 16 of file path.cpp.

```
17 {
18
19 }
```

5.11.2.2 path() [2/2]

```
path::path (
    float width )
```

Constructor.

Create a new path object.

Parameters

<i>width</i>	The width of the path.
--------------	------------------------

See also

[path\(\)](#)

Definition at line 21 of file path.cpp.

```
22 {
23     this->width = width;
24 }
```

5.11.3 Member Function Documentation**5.11.3.1 addPoint()**

```
void path::addPoint (
    point p )
```

adds a new point to the path

Used when customizing path

Parameters

<i>point</i>	new point to add to the path
--------------	------------------------------

Definition at line 11 of file path.cpp.

```
12 {
13     points.push_back(p);
14 }
```

Here is the caller graph for this function:

5.11.4 Member Data Documentation**5.11.4.1 points**

```
vector<point> path::points
```

points added to the path

path is created from these points

Definition at line 43 of file path.h.

5.11.4.2 width

```
int path::width
```

defines width of the path

path width

Definition at line 49 of file path.h.

The documentation for this class was generated from the following files:

- [include/path.h](#)
- [src/path.cpp](#)

5.12 pathFollower Class Reference

```
#include <pathFollower.h>
```

Inheritance diagram for pathFollower:

Collaboration diagram for pathFollower:

Public Member Functions

- [pathFollower](#) ()
- void [initGL](#) (int *argc, char **argv) override

Static Public Member Functions

- static void [loop](#) ()
- static void [createPath](#) ([path](#) &p)

Static Public Attributes

- static [path](#) [myPath](#)

5.12.1 Detailed Description

Definition at line 8 of file pathFollower.h.

5.12.2 Constructor & Destructor Documentation

5.12.2.1 pathFollower()

```
pathFollower::pathFollower ( )
```

Definition at line 35 of file pathFollower.cpp.

```
35     {
36     myPath = path(8);
37     createPath(myPath);
38     name = "path following";
39     createAgent(RANDOM, 40, 0.2, 0.4);
40 }
```

5.12.3 Member Function Documentation

5.12.3.1 createPath()

```
void pathFollower::createPath (
    path & p ) [static]
```

Definition at line 28 of file pathFollower.cpp.

```
28     {
29     p.addPoint(point(-40, 5));
30     p.addPoint(point(-14, 15));
31     p.addPoint(point( 10, 7));
32     p.addPoint(point( 40, 12));
33 }
```

Here is the call graph for this function:

5.12.3.2 initGL()

```
void pathFollower::initGL (
    int * argc,
    char ** argv ) [override], [virtual]
```

Implements [scenario](#).

Definition at line 10 of file pathFollower.cpp.

```
10     {
11     void(* callback) ();
12     callback = reinterpret_cast <void(*)()> ( (void *)(&loop) );
13     view.initGraphics(argc, argv, callback);
14 }
```

Here is the caller graph for this function:

5.12.3.3 loop()

```
void pathFollower::loop ( ) [static]
```

Definition at line 16 of file pathFollower.cpp.

```
16     {
17     for(auto it = agents.begin(); it < agents.end(); it++){
18         view.drawPath(myPath, myColor);
19         pvector seek = behavior.stayInPath_2(*it, myPath, view);
20         pvector sep = behavior.separation(agents, *it);
21         sep.mul(5);
22         (*it).force = sep + seek;
23     }
24
25     refresh();
26 }
```

Here is the call graph for this function:

5.12.4 Member Data Documentation

5.12.4.1 myPath

```
path pathFollower::myPath [static]
```

Definition at line 12 of file pathFollower.h.

The documentation for this class was generated from the following files:

- include/[pathFollower.h](#)
- src/[pathFollower.cpp](#)

5.13 point Class Reference

```
#include <point.h>
```

Collaboration diagram for point:

Public Member Functions

- [point](#) (float [x](#), float [y](#))
- [point](#) ()
- void [div](#) (float [d](#))
- void [mul](#) (float [d](#))
- void [print](#) (const string &[s](#))
- [point operator+](#) ([pvector](#) const &[obj](#))
- [point operator+](#) ([point](#) const &[obj](#))
- [pvector operator-](#) ([point](#) const &[obj](#))
- bool [operator==](#) ([point](#) const &[obj](#))
- void [getNormalPoint](#) ([point](#) [predicted](#), [point](#) [start](#), [point](#) [end](#))

Public Attributes

- float [x](#)
- float [y](#)

5.13.1 Detailed Description

Definition at line 8 of file [point.h](#).

5.13.2 Constructor & Destructor Documentation

5.13.2.1 [point\(\)](#) [1/2]

```
point::point (
    float x,
    float y )
```

Definition at line 8 of file [point.cpp](#).

```
8      {
9      this->x = x;
10     this->y = y;
11 }
```

5.13.2.2 [point\(\)](#) [2/2]

```
point::point ( )
```

Definition at line 13 of file [point.cpp](#).

```
13 {}
```

Here is the caller graph for this function:

5.13.3 Member Function Documentation

5.13.3.1 div()

```
void point::div (
    float d )
```

Definition at line 28 of file point.cpp.

```
28     {
29         x = x / d;
30         y = y / d;
31     }
```

Here is the caller graph for this function:

5.13.3.2 getNormalPoint()

```
void point::getNormalPoint (
    point predicted,
    point start,
    point end )
```

Definition at line 53 of file point.cpp.

```
53     {
54         pvector a = predicted - start;
55         pvector b = end - start;
56         b.normalize();
57         float a_dot_b = a.dotProduct(b);
58         b.mul(a_dot_b);
59         point normalPoint = start + b;
60         this->x = normalPoint.x;
61         this->y = normalPoint.y;
62     }
```

Here is the call graph for this function: Here is the caller graph for this function:

5.13.3.3 mul()

```
void point::mul (
    float d )
```

Definition at line 33 of file point.cpp.

```
33     {
34         x = x * d;
35         y = y * d;
36     }
```

Here is the caller graph for this function:

5.13.3.4 operator+() [1/2]

```
point point::operator+ (
    point const & obj )
```

Definition at line 39 of file point.cpp.

```
39     {
40         point res;
41         res.x = x + obj.x;
42         res.y = y + obj.y;
43         return res;
44     }
```

5.13.3.5 operator+() [2/2]

```
point point::operator+ (
    pvector const & obj )
```

Definition at line 15 of file point.cpp.

```
15 {
16     point res;
17     res.x = x + obj.x;
18     res.y = y + obj.y;
19     return res;
20 }
```

5.13.3.6 operator-()

```
pvector point::operator- (
    point const & obj )
```

Definition at line 46 of file point.cpp.

```
46 {
47     pvector res;
48     res.x = x - obj.x;
49     res.y = y - obj.y;
50     return res;
51 }
```

5.13.3.7 operator==()

```
bool point::operator==(
    point const & obj )
```

Definition at line 22 of file point.cpp.

```
22 {
23     if(x == obj.x && y == obj.y)
24         return true;
25     return false;
26 }
```

5.13.3.8 print()

```
void point::print (
    const string & s )
```

Definition at line 64 of file point.cpp.

```
64 {
65     cout << " " << s << " " << x << " " << y << endl;
66 }
```

5.13.4 Member Data Documentation

5.13.4.1 x

```
float point::x
```

Definition at line 10 of file point.h.

5.13.4.2 y

```
float point::y
```

Definition at line 11 of file point.h.

The documentation for this class was generated from the following files:

- [include/point.h](#)
- [src/point.cpp](#)

5.14 prison Class Reference

```
#include <prison.h>
```

Inheritance diagram for prison:

Collaboration diagram for prison:

Public Member Functions

- [prison](#) ()
- void [initGL](#) (int *argc, char **argv) override

Static Public Member Functions

- static void [loop](#) ()

Additional Inherited Members

5.14.1 Detailed Description

Definition at line 8 of file prison.h.

5.14.2 Constructor & Destructor Documentation

5.14.2.1 prison()

```
prison::prison ( )
```

Definition at line 23 of file prison.cpp.

```
23 {
24     name = "stay in prison";
25     createAgent(RANDOM, 30, 0.5, 0.5);
26 }
```

5.14.3 Member Function Documentation

5.14.3.1 initGL()

```
void prison::initGL (
    int * argc,
    char ** argv ) [override], [virtual]
```

Implements [scenario](#).

Definition at line 8 of file prison.cpp.

```
8 {
9     void(* callback)();
10    callback = reinterpret_cast <void(*)()> ( (void *)(&loop) );
11    view.initGraphics(argc, argv, callback);
12 }
```

Here is the caller graph for this function:

5.14.3.2 loop()

```
void prison::loop ( ) [static]
```

Definition at line 14 of file prison.cpp.

```
14 {
15     for(auto it = agents.begin(); it < agents.end(); it++){
16         view.drawWall(WALL, myColor);
17         (*it).force = behavior.stayInArea(*it, WALL - DISTANCE);
18         (*it).force += behavior.separation(agents, *it);
19     }
20     refresh();
21 }
```

The documentation for this class was generated from the following files:

- [include/prison.h](#)
- [src/prison.cpp](#)

5.15 pursuit Class Reference

```
#include <pursuit.h>
```

Inheritance diagram for pursuit:

Collaboration diagram for pursuit:

Public Member Functions

- [pursuit](#) ()
- void [initGL](#) (int *argc, char **argv) override

Static Public Member Functions

- static void [loop](#) ()

Additional Inherited Members

5.15.1 Detailed Description

Definition at line 8 of file `pursuit.h`.

5.15.2 Constructor & Destructor Documentation

5.15.2.1 `pursuit()`

```
pursuit::pursuit ( )
```

Definition at line 29 of file `pursuit.cpp`.

```
29     {
30         name = "pursuit";
31         createAgent(STATIC, 0, 0, 0);
32     }
```

5.15.3 Member Function Documentation

5.15.3.1 `initGL()`

```
void pursuit::initGL (
    int * argc,
    char ** argv ) [override], [virtual]
```

Implements [scenario](#).

Definition at line 8 of file `pursuit.cpp`.

```
8     {
9         void(* callback)();
10        callback = reinterpret_cast <void(*)()> ( (void *)(&loop) );
11        view.initGraphics(argc, argv, callback);
12    }
```

Here is the caller graph for this function:

5.15.3.2 loop()

```
void pursuit::loop ( ) [static]
```

Definition at line 14 of file pursuit.cpp.

```
14      {
15      for(auto it = agents.begin(); it < agents.end(); it++){
16          if((*it).name == "gazelle"){
17              (*it).targetPoint = view.getMousePosition();
18              (*it).force = behavior.seek(*it);
19          }
20          else{//lion
21              (*it).force = behavior.pursuit(agents, *it, view);
22          }
23          (*it).arrive = true;
24      }
25
26      refresh();
27 }
```

The documentation for this class was generated from the following files:

- include/pursuit.h
- src/pursuit.cpp

5.16 pvector Class Reference

```
#include <pvector.h>
```

Collaboration diagram for pvector:

Public Member Functions

- [pvector \(\)](#)
- [pvector \(float x, float y\)](#)
- [float magnitude \(\)](#)
- [pvector & normalize \(\)](#)
- [void div \(float i\)](#)
- [void mul \(float i\)](#)
- [void add \(pvector p\)](#)
- [void limit \(float limit\)](#)
- [float getAngle \(\)](#)
- [float dotProduct \(pvector v\)](#)
- [float angleBetween \(pvector v\)](#)
- [pvector operator+= \(pvector const &obj\)](#)
- [pvector operator+ \(pvector const &obj\)](#)
- [pvector operator- \(pvector const &obj\)](#)
- [pvector operator- \(point const &obj\)](#)
- [pvector operator+ \(point const &obj\)](#)
- [bool operator== \(pvector const &obj\)](#)
- [void print \(const string &s\)](#)

Public Attributes

- [float x](#)
- [float y](#)

5.16.1 Detailed Description

Definition at line 11 of file pvector.h.

5.16.2 Constructor & Destructor Documentation

5.16.2.1 pvector() [1/2]

```
pvector::pvector ( )
```

Definition at line 25 of file pvector.cpp.
25 {}

5.16.2.2 pvector() [2/2]

```
pvector::pvector (
    float x,
    float y )
```

Definition at line 27 of file pvector.cpp.
27 {
28 this->x = x;
29 this->y = y;
30 }

5.16.3 Member Function Documentation

5.16.3.1 add()

```
void pvector::add (
    pvector p )
```

Definition at line 42 of file pvector.cpp.
42 {
43 x = x + p.x;
44 y = y + p.y;
45 }

5.16.3.2 angleBetween()

```
float pvector::angleBetween (
    pvector v )
```

Definition at line 15 of file pvector.cpp.

```
15     {
16     float angle = this->dotProduct(v) / (this->magnitude() * v.magnitude());
17     angle = acos(angle) * 180 / PI;
18     return angle;
19 }
```

Here is the call graph for this function: Here is the caller graph for this function:

5.16.3.3 div()

```
void pvector::div (
    float i )
```

Definition at line 32 of file pvector.cpp.

```
32     {
33     x = x / i;
34     y = y / i;
35 }
```

Here is the caller graph for this function:

5.16.3.4 dotProduct()

```
float pvector::dotProduct (
    pvector v )
```

Definition at line 21 of file pvector.cpp.

```
21     {
22     return ((x * v.x) + (y * v.y));
23 }
```

Here is the caller graph for this function:

5.16.3.5 getAngle()

```
float pvector::getAngle ( )
```

Definition at line 9 of file pvector.cpp.

```
9     {
10     float angle;
11     angle = atan2 (this->y, this->x) * 180 / PI;
12     return angle;
13 }
```

Here is the caller graph for this function:

5.16.3.6 limit()

```
void pvector::limit (
    float limit )
```

Definition at line 64 of file pvector.cpp.

```
64     {
65     this->normalize();
66     this->mul(limit);
67 }
```

Here is the call graph for this function: Here is the caller graph for this function:

5.16.3.7 magnitude()

```
float pvector::magnitude ( )
```

Definition at line 47 of file pvector.cpp.

```
47     {
48     return sqrt((this->x * this->x) + (this->y * this->y));
49 }
```

Here is the caller graph for this function:

5.16.3.8 mul()

```
void pvector::mul (
    float i )
```

Definition at line 37 of file pvector.cpp.

```
37     {
38     x = x * i;
39     y = y * i;
40 }
```

Here is the caller graph for this function:

5.16.3.9 normalize()

```
pvector & pvector::normalize ( )
```

Definition at line 51 of file pvector.cpp.

```
51     {
52     float magnitude = this->magnitude();
53     if(magnitude != 0){
54         this->x = this->x / magnitude;
55         this->y = this->y / magnitude;
56     }
57     else{
58         this->x = 0;
59         this->y = 0;
60     }
61     return *this;
62 }
```

Here is the caller graph for this function:

5.16.3.10 operator+() [1/2]

```
pvector pvector::operator+ (
    point const & obj )
```

Definition at line 88 of file pvector.cpp.

```
88 {
89     pvector res;
90     res.x = x + obj.x;
91     res.y = y + obj.y;
92     return res;
93 }
```

5.16.3.11 operator+() [2/2]

```
pvector pvector::operator+ (
    pvector const & obj )
```

Definition at line 69 of file pvector.cpp.

```
69 {
70     pvector res;
71     res.x = x + obj.x;
72     res.y = y + obj.y;
73     return res;
74 }
```

5.16.3.12 operator+=()

```
pvector pvector::operator+= (
    pvector const & obj )
```

Definition at line 76 of file pvector.cpp.

```
76 {
77     x = x + obj.x;
78     y = y + obj.y;
79     return *this;
80 }
```

5.16.3.13 operator-() [1/2]

```
pvector pvector::operator- (
    point const & obj )
```

Definition at line 95 of file pvector.cpp.

```
95 {
96     pvector res;
97     res.x = x - obj.x;
98     res.y = y - obj.y;
99     return res;
100 }
```

5.16.3.14 operator-() [2/2]

```
pvector pvector::operator- (
    pvector const & obj )
```

Definition at line 106 of file pvector.cpp.

```
106 {
107     pvector res;
108     res.x = x - obj.x;
109     res.y = y - obj.y;
110     return res;
111 }
```

5.16.3.15 operator==()

```
bool pvector::operator== (
    pvector const & obj )
```

Definition at line 82 of file pvector.cpp.

```
82 {
83     if(x == obj.x && y == obj.y)
84         return true;
85     return false;
86 }
```

5.16.3.16 print()

```
void pvector::print (
    const string & s )
```

Definition at line 102 of file pvector.cpp.

```
102 {
103     cout << s << " " << x << " " << y << endl;
104 }
```

5.16.4 Member Data Documentation

5.16.4.1 x

```
float pvector::x
```

Definition at line 13 of file pvector.h.

5.16.4.2 y

```
float pvector::y
```

Definition at line 14 of file pvector.h.

The documentation for this class was generated from the following files:

- [include/pvector.h](#)
- [src/pvector.cpp](#)

5.17 random Class Reference

```
#include <random.h>
```

Collaboration diagram for random:

Static Public Member Functions

- static void [createRandomArray](#) (int *arr, int size)

5.17.1 Detailed Description

Definition at line 3 of file random.h.

5.17.2 Member Function Documentation

5.17.2.1 createRandomArray()

```
void random::createRandomArray (  
    int * arr,  
    int size ) [static]
```

Definition at line 7 of file random.cpp.

```
7                                     {  
8     srand(time(NULL));  
9     for(int i=0; i<size; i++)  
10         arr[i] = i+1;  
11  
12     for (int i=0; i < size; i++){  
13         int r = rand() % size;  
14         swap(arr[i], arr[r]);  
15     }  
16 }
```

The documentation for this class was generated from the following files:

- [include/random.h](#)
- [src/random.cpp](#)

5.18 scenario Class Reference

```
#include <scenario.h>
```

Inheritance diagram for scenario:

Collaboration diagram for scenario:

Public Member Functions

- [scenario](#) ()
- void [createAgent](#) (int type, int count, const float force, const float speed)
- virtual void [initGL](#) (int *argv, char **argc)=0

Static Public Member Functions

- static void [refresh](#) ()

Static Public Attributes

- static vector< [agent](#) > [agents](#)
- static [graphics](#) [view](#)
- static [steeringBehavior](#) [behavior](#)
- static [color](#) [myColor](#)
- static string [name](#)

5.18.1 Detailed Description

Definition at line 12 of file scenario.h.

5.18.2 Constructor & Destructor Documentation

5.18.2.1 scenario()

```
scenario::scenario ( )
```

Definition at line 13 of file scenario.cpp.

```
14 {  
15     srand(time(NULL));  
16     myColor.createColors();  
17     view = graphics();  
18 }
```

5.18.3 Member Function Documentation

5.18.3.1 createAgent()

```
void scenario::createAgent (
    int type,
    int count,
    const float force,
    const float speed )
```

Definition at line 90 of file scenario.cpp.

```
91 {
92     if (type == TROOP){
93         createTroop(count);
94     }
95     else if (type == RANDOM){
96         createRandomAgents(count, force, speed);
97     }
98     else if (type == STATIC){
99         createStaticAgents();
100    }
101    else{
102        //error message
103    }
104 }
```

5.18.3.2 initGL()

```
virtual void scenario::initGL (
    int * argv,
    char ** argc ) [pure virtual]
```

Implemented in [obstacleAvoidance](#), [pathFollower](#), [windy](#), [evade](#), [flee](#), [flock](#), [mouseFollower](#), [prison](#), [pursuit](#), and [wander](#).

5.18.3.3 refresh()

```
void scenario::refresh ( ) [static]
```

Definition at line 20 of file scenario.cpp.

```
20     {
21         for(auto it = agents.begin(); it < agents.end(); it++){
22             (*it).updatePosition((*it).arrive);
23             view.drawAgent(*it, (*it).fillColor);
24         }
25     }
26     view.drawText(name, point(-34, 32.25)); //TODO: magic numbers, define left corner
27     view.refreshScene();
28 }
```

Here is the call graph for this function:

5.18.4 Member Data Documentation

5.18.4.1 agents

```
vector< agent > scenario::agents [static]
```

Definition at line 19 of file scenario.h.

5.18.4.2 behavior

```
steeringBehavior scenario::behavior [static]
```

Definition at line 21 of file scenario.h.

5.18.4.3 myColor

```
color scenario::myColor [static]
```

Definition at line 22 of file scenario.h.

5.18.4.4 name

```
string scenario::name [static]
```

Definition at line 23 of file scenario.h.

5.18.4.5 view

```
graphics scenario::view [static]
```

Definition at line 20 of file scenario.h.

The documentation for this class was generated from the following files:

- include/[scenario.h](#)
- src/[scenario.cpp](#)

5.19 steeringBehavior Class Reference

```
#include <steeringBehavior.h>
```

Collaboration diagram for steeringBehavior:

Public Member Functions

- [pvector](#) [stayInArea](#) ([agent](#) &[agent](#), int [turnPoint](#))
- [pvector](#) [inFlowField](#) ([agent](#) &[agent](#), [flowField](#) &[flow](#))
- [pvector](#) [stayInPath](#) ([agent](#) &[agent](#), [path](#) &[path](#))
- [pvector](#) [stayInPath_2](#) ([agent](#) &[agent](#), [path](#) &[path](#), [graphics](#) view)
- [pvector](#) [seek](#) ([agent](#) &[agent](#))
- [pvector](#) [separation](#) (vector< [agent](#) > [agents](#), [agent](#) &[agent](#))
- [pvector](#) [cohesion](#) (vector< [agent](#) > [boids](#), [agent](#) &[agent](#))
- [pvector](#) [align](#) (vector< [agent](#) > [boids](#), [agent](#) &[agent](#))
- [pvector](#) [wander](#) ([agent](#) &[agent](#))
- [pvector](#) [pursuit](#) (vector< [agent](#) > [boids](#), [agent](#) &[pursuer](#), [graphics](#) view)
- [pvector](#) [evade](#) (vector< [agent](#) > [boids](#), [agent](#) &[evader](#), [graphics](#) view)
- [pvector](#) [flee](#) ([agent](#) &[agent](#), [graphics](#) &[view](#), [point](#) p)
- [pvector](#) [avoid](#) (vector< [obstacle](#) > [obstacles](#), [agent](#) &[agent](#))
- void [setAngle](#) ([pvector](#) &p, float [angle](#))

5.19.1 Detailed Description

Definition at line 28 of file [steeringBehavior.h](#).

5.19.2 Member Function Documentation

5.19.2.1 align()

```
pvector steeringBehavior::align (
    vector< agent > boids,
    agent & agent )
```

Definition at line 105 of file [steeringBehavior.cpp](#).

```
105
106     float neighborDist = 30; //TODO: magic number
107     pvector sum {0,0};
108     int count = 0;
109     for(auto it = boids.begin(); it < boids.end(); it++){
110         float d = (agent.position - (*it).position).magnitude();
111         if( (d > 0) && (d < neighborDist) ){
112             sum += (*it).velocity;
113             count++;
114         }
115     }
116     if(count > 0){
117         sum.div(count);
118         sum.normalize().mul(agent.maxSpeed);
119         agent.steering = sum - agent.velocity;
120         return agent.steering;
121     }
122     return pvector(0,0);
123 }
```

Here is the call graph for this function:

5.19.2.2 avoid()

```
pvector steeringBehavior::avoid (
    vector< obstacle > obstacles,
    agent & agent )
```

Definition at line 166 of file steeringBehavior.cpp.

```
166 {
167     float dynamic_length = agent.velocity.magnitude() / agent.maxSpeed;
168     pvector vel = agent.velocity;
169     vel.normalize().mul(dynamic_length);
170     pvector ahead = vel + agent.position;
171     vel.mul(6);
172     pvector ahead2 = vel + agent.position;
173     //view.drawPoint(point(ahead.x, ahead.y));
174     //view.drawPoint(point(ahead2.x, ahead2.y));
175
176     for(auto it = obstacles.begin(); it < obstacles.end(); it++){
177         float dist = (ahead - (*it).p).magnitude();
178         float dist2 = (ahead2 - (*it).p).magnitude();
179         if(dist < (*it).r + 2 || dist2 < (*it).r + 2){
180             pvector avoidance = ahead - (*it).p;
181             avoidance.normalize().mul(20);
182             /*a = point(avoidance.x, avoidance.y);
183             view.drawLine(agent.position, agent.position + a, color(0,1,0));*/
184             return avoidance;
185         }
186     }
187     return pvector(0,0);
188 }
```

Here is the call graph for this function:

5.19.2.3 cohesion()

```
pvector steeringBehavior::cohesion (
    vector< agent > boids,
    agent & agent )
```

Definition at line 125 of file steeringBehavior.cpp.

```
125 {
126     float neighborDist = 20; //TODO: magic number
127     point sum {0,0};
128     int count = 0;
129     for(auto it = boids.begin(); it < boids.end(); it++){
130         float d = (agent.position - (*it).position).magnitude();
131         if( (d > 0) && (d < neighborDist) ){
132             sum = sum + (*it).position;
133             count++;
134         }
135     }
136     if(count > 0){
137         sum.div(count);
138         agent.targetPoint = sum;
139         return seek(agent);
140     }
141     return pvector(0,0);
142 }
```

Here is the call graph for this function:

5.19.2.4 evade()

```
pvector steeringBehavior::evade (
    vector< agent > boids,
    agent & evader,
    graphics view )
```

Definition at line 36 of file steeringBehavior.cpp.

```

36                                     {
37     agent target;
38     for(auto it = boids.begin(); it < boids.end(); it++){
39         if((*it).name == "lion"){
40             target = *it;
41         }
42     }
43
44     point p = point(evader.position.x + 2, evader.position.y - 2);
45     view.drawText(evader.name, p);
46     p = point(target.position.x + 2, target.position.y - 2);
47     view.drawText(target.name, p);
48
49     pvector targetVel = target.velocity;
50     targetVel.mul(5); //TODO: magic number
51
52     point futurePos = target.position + targetVel;
53     view.drawPoint(futurePos);
54
55     pvector dist = evader.position - futurePos;
56     dist.normalize().mul(1 / dist.magnitude());
57
58     evader.targetPoint = evader.position + dist;
59     return flee(evader, view, futurePos);
60 }
```

Here is the call graph for this function:

5.19.2.5 flee()

```

pvector steeringBehavior::flee (
    agent & agent,
    graphics & view,
    point p )
```

Definition at line 20 of file steeringBehavior.cpp.

```

20                                     {
21     pvector dist = agent.targetPoint - p;
22     view.drawPoint(agent.targetPoint);
23
24     if(dist.magnitude() < 15){ //TODO: magic number
25         agent.arrive = false;
26         agent.desiredVelocity = agent.position - p;
27     }
28     else{
29         agent.arrive = true;
30         agent.desiredVelocity = agent.targetPoint - agent.position;
31     }
32     agent.steering = agent.desiredVelocity - agent.velocity;
33     return agent.steering;
34 }
```

Here is the call graph for this function:

5.19.2.6 inFlowField()

```

pvector steeringBehavior::inFlowField (
    agent & agent,
    flowField & flow )
```

Definition at line 236 of file steeringBehavior.cpp.

```

236                                     {
237     //pos_x, pos_y must be non negative integer
238     int pos_x = abs((int)agent.position.x) % WIDTH;
239     int pos_y = abs((int)agent.position.y) % HEIGHT;
240     //TODO: modification required for non uniform fields
241     return flow.getField(pos_x, pos_y);
242 }
```

Here is the call graph for this function:

5.19.2.7 pursuit()

```
pvector steeringBehavior::pursuit (
    vector< agent > boids,
    agent & pursuer,
    graphics view )
```

Definition at line 62 of file steeringBehavior.cpp.

```
62 {
63     agent target;
64     for(auto it = boids.begin(); it < boids.end(); it++){
65         if((*it).name == "gazelle"){
66             target = *it;
67         }
68     }
69
70     point p = point(target.position.x + 2, target.position.y - 2);
71     view.drawText(target.name, p);
72     p = point(pursuer.position.x + 2, pursuer.position.y - 2);
73     view.drawText(pursuer.name, p);
74
75     float dist = (target.position - pursuer.position).magnitude();
76     float t = dist / target.maxSpeed;
77
78     pvector targetVel = target.velocity;
79     targetVel.mul(t);
80     point futurePos = target.position + targetVel;
81     pursuer.targetPoint = futurePos;
82     return seek(pursuer);
83 }
```

Here is the call graph for this function:

5.19.2.8 seek()

```
pvector steeringBehavior::seek (
    agent & agent )
```

Definition at line 190 of file steeringBehavior.cpp.

```
190 {
191     agent.desiredVelocity = agent.targetPoint - agent.position;
192     agent.steering = agent.desiredVelocity - agent.velocity;
193     return agent.steering;
194 }
```

5.19.2.9 separation()

```
pvector steeringBehavior::separation (
    vector< agent > agents,
    agent & agent )
```

Definition at line 144 of file steeringBehavior.cpp.

```
144 {
145     float desiredSeparation = 5; //TODO: magic number
146     pvector sum = pvector(0,0);
147     int count = 0;
148     for(auto it = agents.begin(); it < agents.end(); it++){
149         float d = (agent.position - (*it).position).magnitude();
150         if( (d > 0) && (d < desiredSeparation) ){
151             pvector diff = agent.position - (*it).position;
152             diff.normalize().div(d);
153             sum = sum + diff;
154             count++;
155         }
156     }
157     if(count > 0){
158         sum.div(count);
159         sum.normalize().mul(agent.maxSpeed);
160         agent.steering = sum - agent.velocity;
161         return agent.steering;
162     }
163     return pvector(0,0);
164 }
```

Here is the call graph for this function:

5.19.2.10 setAngle()

```
void steeringBehavior::setAngle (
    pvector & p,
    float angle )
```

Definition at line 15 of file steeringBehavior.cpp.

```
15
16     p.x = cos ( angle * PI / 180.0 );
17     p.y = sin ( angle * PI / 180.0 );
18 }
```

5.19.2.11 stayInArea()

```
pvector steeringBehavior::stayInArea (
    agent & agent,
    int turnPoint )
```

Definition at line 244 of file steeringBehavior.cpp.

```
244
245     if(agent.position.x >= turnPoint){
246         agent.desiredVelocity = pvector( -agent.maxSpeed, agent.velocity.y );
247         agent.steering = agent.desiredVelocity - agent.velocity;
248         return agent.steering;
249     }
250     else if(agent.position.x <= -turnPoint){
251         agent.desiredVelocity = pvector( agent.maxSpeed, agent.velocity.y );
252         agent.steering = agent.desiredVelocity - agent.velocity;
253         return agent.steering;
254     }
255     else if(agent.position.y >= turnPoint){
256         agent.desiredVelocity = pvector( agent.velocity.x, -agent.maxSpeed );
257         agent.steering = agent.desiredVelocity - agent.velocity;
258         return agent.steering;
259     }
260     else if(agent.position.y <= -turnPoint){
261         agent.desiredVelocity = pvector( agent.velocity.x, agent.maxSpeed );
262         agent.steering = agent.desiredVelocity - agent.velocity;
263         return agent.steering;
264     }
265     return pvector(0,0);
266 }
```

5.19.2.12 stayInPath()

```
pvector steeringBehavior::stayInPath (
    agent & agent,
    path & path )
```

Definition at line 218 of file steeringBehavior.cpp.

```
218
219     point start = path.points.at(0);
220     point end = path.points.at(1);
221     point predictedPos = agent.position + agent.velocity;
222     point normalPoint;
223     normalPoint.getNormalPoint(predictedPos, start, end);
224     pvector b = end - start;
225     b.normalize();
226
227     pvector distance = predictedPos - normalPoint;
228     agent.targetPoint = normalPoint + b;
229     //view.drawLine(predictedPos, normalPoint);
230     //view.drawPoint(targetPoint);
231     if(distance.magnitude() > path.width / 8)
232         return seek(agent);
233     return pvector(0,0);
234 }
```

Here is the call graph for this function:

5.19.2.13 stayInPath_2()

```
pvector steeringBehavior::stayInPath_2 (
    agent & agent,
    path & path,
    graphics view )
```

Definition at line 196 of file steeringBehavior.cpp.

```
196 {
197     float worldRecord = 1000000; //TODO: magic number
198     point normalPoint, predictedPos, start, end;
199     pvector distance;
200     for(auto it = path.points.begin(); it < path.points.end()-1; it++){
201         start = point ((*it).x, (*it).y);
202         end = point ((*it+1).x, (*it+1).y);
203         predictedPos = agent.position + agent.velocity;
204         normalPoint.getNormalPoint(predictedPos, start, end);
205         if (normalPoint.x < start.x || normalPoint.x > end.x){
206             normalPoint = end;
207         }
208         distance = predictedPos - normalPoint;
209         if (distance.magnitude() < worldRecord){
210             worldRecord = distance.magnitude();
211             agent.targetPoint = end;
212         }
213         view.drawPoint(agent.targetPoint);
214     }
215     return seek(agent);
216 }
```

Here is the call graph for this function:

5.19.2.14 wander()

```
pvector steeringBehavior::wander (
    agent & agent )
```

Definition at line 85 of file steeringBehavior.cpp.

```
85 {
86     pvector circleCenter = agent.velocity;
87     circleCenter.normalize().mul(CIRCLE_DISTANCE + CIRCLE_RADIUS);
88
89     int wanderAngle = (rand() % 360);
90     pvector displacement {0, 1};
91     setAngle(displacement, wanderAngle);
92     displacement.mul(CIRCLE_RADIUS);
93
94     agent.desiredVelocity = displacement + circleCenter;
95     agent.steering = agent.desiredVelocity - agent.velocity;
96
97     //move it to the center when it is out of screen
98     if(agent.position.x > WIDTH || agent.position.x < -WIDTH ||
99        agent.position.y > HEIGHT || agent.position.y < -HEIGHT)
100         agent.position = point(0,0);
101
102     return agent.steering;
103 }
```

Here is the call graph for this function:

The documentation for this class was generated from the following files:

- include/steeringBehavior.h
- src/steeringBehavior.cpp

5.20 wander Class Reference

```
#include <wander.h>
```

Inheritance diagram for wander:

Collaboration diagram for wander:

Public Member Functions

- [wander](#) ()
- void [initGL](#) (int *argc, char **argv) override

Static Public Member Functions

- static void [loop](#) ()

Additional Inherited Members

5.20.1 Detailed Description

Definition at line 8 of file wander.h.

5.20.2 Constructor & Destructor Documentation

5.20.2.1 wander()

```
wander::wander ( )
```

Definition at line 22 of file wander.cpp.

```
22     {  
23         name = "wandering objects";  
24         createAgent(RANDOM, 30, 0.3, 0.6);  
25     }
```

5.20.3 Member Function Documentation

5.20.3.1 initGL()

```
void wander::initGL (
    int * argc,
    char ** argv ) [override], [virtual]
```

Implements [scenario](#).

Definition at line 8 of file wander.cpp.

```
8      {
9      void(* callback)();
10     callback = reinterpret_cast <void(*)()> ( (void *)(&loop) );
11     view.initGraphics(argc, argv, callback);
12 }
```

Here is the caller graph for this function:

5.20.3.2 loop()

```
void wander::loop ( ) [static]
```

Definition at line 14 of file wander.cpp.

```
14     {
15     for(auto it = agents.begin(); it < agents.end(); it++){
16         (*it).force = behavior.wander(*it);
17     }
18
19     refresh();
20 }
```

The documentation for this class was generated from the following files:

- include/[wander.h](#)
- src/[wander.cpp](#)

5.21 windy Class Reference

```
#include <windy.h>
```

Inheritance diagram for windy:

Collaboration diagram for windy:

Public Member Functions

- [windy](#) ()
- void [initGL](#) (int *argc, char **argv) override

Static Public Member Functions

- static void [loop](#) ()

Static Public Attributes

- static [flowField](#) [flow](#)

5.21.1 Detailed Description

Definition at line 9 of file windy.h.

5.21.2 Constructor & Destructor Documentation

5.21.2.1 windy()

```
windy::windy ( )
```

Definition at line 27 of file windy.cpp.

```
27     {
28         name = "flow field";
29         createAgent(RANDOM, 30, 0.3, 0.6);
30     }
```

5.21.3 Member Function Documentation

5.21.3.1 initGL()

```
void windy::initGL (
    int * argc,
    char ** argv ) [override], [virtual]
```

Implements [scenario](#).

Definition at line 10 of file windy.cpp.

```
10     {
11         void(* callback)();
12         callback = reinterpret_cast<void(*)()> ( (void *)(&loop) );
13         view.initGraphics(argc, argv, callback);
14     }
```

Here is the caller graph for this function:

5.21.3.2 loop()

```
void windy::loop ( ) [static]
```

Definition at line 16 of file windy.cpp.

```
16     {
17         for(auto it = agents.begin(); it < agents.end(); it++){
18             flow = flowField(pvector(GRAVITY));
19             (*it).force = behavior.inFlowField(*it, flow);
20
21             flow = flowField(pvector(WIND_WEST));
22             (*it).force += behavior.inFlowField(*it, flow);
23         }
24         refresh();
25     }
```

5.21.4 Member Data Documentation

5.21.4.1 flow

```
flowField windy::flow [static]
```

Definition at line 13 of file windy.h.

The documentation for this class was generated from the following files:

- include/[windy.h](#)
- src/[windy.cpp](#)

Chapter 6

File Documentation

6.1 include/agent.h File Reference

```
#include "point.h"
#include "color.h"
#include "flowField.h"
#include <vector>
#include <string>
Include dependency graph for agent.h:
```

6.2 include/color.h File Reference

color class used for agent, path, wall etc. color

```
#include <vector>
Include dependency graph for color.h: This graph shows which files directly or indirectly include this file:
```

Classes

- class [color](#)

Enumerations

- enum [num](#) {
 [BLACK](#) =0, [BLUE](#), [GREEN](#), [CYAN](#),
 [RED](#), [MAGENDA](#), [YELLOW](#), [WHITE](#) }
 used to get color from colors vector

6.2.1 Detailed Description

color class used for agent, path, wall etc. color

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

13.05.2021

6.2.2 Enumeration Type Documentation

6.2.2.1 num

enum [num](#)

used to get color from colors vector

color names for fundamental colors

Enumerator

BLACK	
BLUE	
GREEN	
CYAN	
RED	
MAGENDA	
YELLOW	
WHITE	

Definition at line 18 of file color.h.

```
18 { BLACK=0, BLUE, GREEN, CYAN, RED, MAGENDA, YELLOW, WHITE };
```

6.3 include/evade.h File Reference

```
#include "scenario.h"
```

```
#include <vector>
```

Include dependency graph for evade.h: This graph shows which files directly or indirectly include this file:

Classes

- class [evade](#)

6.4 include/flee.h File Reference

```
#include "scenario.h"
```

```
#include <vector>
```

Include dependency graph for flee.h: This graph shows which files directly or indirectly include this file:

Classes

- class [flee](#)

6.5 include/flock.h File Reference

```
#include "scenario.h"
#include <vector>
```

Include dependency graph for flock.h: This graph shows which files directly or indirectly include this file:

Classes

- class [flock](#)

6.6 include/flowField.h File Reference

[flowField](#) class, screen can be filled with a force for each pixel

```
#include "pvector.h"
```

Include dependency graph for flowField.h: This graph shows which files directly or indirectly include this file:

Classes

- class [flowField](#)

Macros

- #define [WIDTH](#) 34
- #define [HEIGHT](#) 34
- #define [WIND_WEST](#) 0.1, 0.0
- #define [GRAVITY](#) 0.0, -0.1

6.6.1 Detailed Description

[flowField](#) class, screen can be filled with a force for each pixel

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

13.05.2021

6.6.2 Macro Definition Documentation

6.6.2.1 GRAVITY

```
#define GRAVITY 0.0, -0.1
```

Definition at line 16 of file flowField.h.

6.6.2.2 HEIGHT

```
#define HEIGHT 34
```

Definition at line 13 of file flowField.h.

6.6.2.3 WIDTH

```
#define WIDTH 34
```

Definition at line 12 of file flowField.h.

6.6.2.4 WIND_WEST

```
#define WIND_WEST 0.1, 0.0
```

Definition at line 15 of file flowField.h.

6.7 include/graphics.h File Reference

```
#include "agent.h"
```

```
#include "path.h"
```

Include dependency graph for graphics.h: This graph shows which files directly or indirectly include this file:

Classes

- class [graphics](#)

Macros

- #define [WIDTH](#) 34
- #define [HEIGHT](#) 34
- #define [ESC](#) 27
- #define [PI](#) 3.14159265

6.7.1 Macro Definition Documentation

6.7.1.1 ESC

```
#define ESC 27
```

Definition at line 9 of file graphics.h.

6.7.1.2 HEIGHT

```
#define HEIGHT 34
```

Definition at line 7 of file graphics.h.

6.7.1.3 PI

```
#define PI 3.14159265
```

Definition at line 10 of file graphics.h.

6.7.1.4 WIDTH

```
#define WIDTH 34
```

Definition at line 6 of file graphics.h.

6.8 include/mouseFollower.h File Reference

```
#include "scenario.h"  
#include <vector>
```

Include dependency graph for mouseFollower.h: This graph shows which files directly or indirectly include this file:

Classes

- class [mouseFollower](#)

6.9 include/obstacle.h File Reference

circular obstacles for agent avoidance behaviors

```
#include "point.h"
```

Include dependency graph for obstacle.h: This graph shows which files directly or indirectly include this file:

Classes

- class [obstacle](#)

6.9.1 Detailed Description

circular obstacles for agent avoidance behaviors

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

12.05.2021

6.10 include/obstacleAvoidance.h File Reference

```
#include "scenario.h"
```

```
#include "obstacle.h"
```

```
#include <vector>
```

Include dependency graph for obstacleAvoidance.h: This graph shows which files directly or indirectly include this file:

Classes

- class [obstacleAvoidance](#)

6.11 include/path.h File Reference

path class used for path following steering behaviors.

```
#include "point.h"
```

```
#include <vector>
```

Include dependency graph for path.h: This graph shows which files directly or indirectly include this file:

Classes

- class [path](#)

6.11.1 Detailed Description

path class used for path following steering behaviors.

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

12.05.2021

6.12 include/pathFollower.h File Reference

```
#include "scenario.h"
#include <vector>
```

Include dependency graph for pathFollower.h: This graph shows which files directly or indirectly include this file:

Classes

- class [pathFollower](#)

6.13 include/point.h File Reference

```
#include "pvector.h"
#include <string>
```

Include dependency graph for point.h: This graph shows which files directly or indirectly include this file:

Classes

- class [point](#)

6.14 include/prison.h File Reference

```
#include "scenario.h"
#include <vector>
```

Include dependency graph for prison.h: This graph shows which files directly or indirectly include this file:

Classes

- class [prison](#)

6.15 include/pursuit.h File Reference

```
#include "scenario.h"  
#include <vector>
```

Include dependency graph for pursuit.h: This graph shows which files directly or indirectly include this file:

Classes

- class [pursuit](#)

6.16 include/pvector.h File Reference

```
#include <string>
```

Include dependency graph for pvector.h: This graph shows which files directly or indirectly include this file:

Classes

- class [pvector](#)

Macros

- #define [PI](#) 3.14159265

6.16.1 Macro Definition Documentation

6.16.1.1 PI

```
#define PI 3.14159265
```

Definition at line 5 of file pvector.h.

6.17 include/random.h File Reference

This graph shows which files directly or indirectly include this file:

Classes

- class [random](#)

6.18 include/scenario.h File Reference

```
#include "agent.h"
#include "graphics.h"
#include "steeringBehavior.h"
#include <vector>
```

Include dependency graph for scenario.h: This graph shows which files directly or indirectly include this file:

Classes

- class [scenario](#)

Enumerations

- enum [types](#) { [RANDOM](#) =0, [STATIC](#), [TROOP](#) }

6.18.1 Enumeration Type Documentation

6.18.1.1 types

```
enum types
```

Enumerator

RANDOM	
STATIC	
TROOP	

Definition at line 10 of file scenario.h.

```
10 { RANDOM=0, STATIC, TROOP };
```

6.19 include/steeringBehavior.h File Reference

```
#include "flowField.h"
#include <vector>
#include "graphics.h"
#include "obstacle.h"
```

Include dependency graph for steeringBehavior.h: This graph shows which files directly or indirectly include this file:

Classes

- class [steeringBehavior](#)

Macros

- `#define CIRCLE_DISTANCE 0.1`
- `#define CIRCLE_RADIUS 0.4`
- `#define FOLLOW_MOUSE 1`
- `#define STAY_IN_FIELD 2`
- `#define IN_FLOW_FIELD 3`
- `#define AVOID_OBSTACLE 4`
- `#define STAY_IN_PATH 5`
- `#define FLOCK 6`
- `#define WANDER 7`
- `#define FLEE 8`
- `#define PURSUIT 9`
- `#define EVADE 10`

6.19.1 Macro Definition Documentation

6.19.1.1 AVOID_OBSTACLE

```
#define AVOID_OBSTACLE 4
```

Definition at line 14 of file steeringBehavior.h.

6.19.1.2 CIRCLE_DISTANCE

```
#define CIRCLE_DISTANCE 0.1
```

Definition at line 8 of file steeringBehavior.h.

6.19.1.3 CIRCLE_RADIUS

```
#define CIRCLE_RADIUS 0.4
```

Definition at line 9 of file steeringBehavior.h.

6.19.1.4 EVADE

```
#define EVADE 10
```

Definition at line 20 of file steeringBehavior.h.

6.19.1.5 FLEE

```
#define FLEE 8
```

Definition at line 18 of file steeringBehavior.h.

6.19.1.6 FLOCK

```
#define FLOCK 6
```

Definition at line 16 of file steeringBehavior.h.

6.19.1.7 FOLLOW_MOUSE

```
#define FOLLOW_MOUSE 1
```

Definition at line 11 of file steeringBehavior.h.

6.19.1.8 IN_FLOW_FIELD

```
#define IN_FLOW_FIELD 3
```

Definition at line 13 of file steeringBehavior.h.

6.19.1.9 PURSUIT

```
#define PURSUIT 9
```

Definition at line 19 of file steeringBehavior.h.

6.19.1.10 STAY_IN_FIELD

```
#define STAY_IN_FIELD 2
```

Definition at line 12 of file steeringBehavior.h.

6.19.1.11 STAY_IN_PATH

```
#define STAY_IN_PATH 5
```

Definition at line 15 of file steeringBehavior.h.

6.19.1.12 WANDER

```
#define WANDER 7
```

Definition at line 17 of file steeringBehavior.h.

6.20 include/wander.h File Reference

```
#include "scenario.h"  
#include <vector>
```

Include dependency graph for wander.h: This graph shows which files directly or indirectly include this file:

Classes

- class [wander](#)

6.21 include/windy.h File Reference

```
#include "scenario.h"  
#include "flowField.h"  
#include <vector>
```

Include dependency graph for windy.h: This graph shows which files directly or indirectly include this file:

Classes

- class [windy](#)

6.22 main.cpp File Reference

```
#include <iostream>  
#include "mouseFollower.h"  
#include "prison.h"  
#include "windy.h"  
#include "wander.h"  
#include "pursuit.h"  
#include "flee.h"  
#include "evade.h"  
#include "flock.h"  
#include "pathFollower.h"  
#include "obstacleAvoidance.h"
```

Include dependency graph for main.cpp:

Functions

- void `menu` ()
- int `main` (int argc, char **argv)

Variables

- int `mode`

6.22.1 Function Documentation

6.22.1.1 `main()`

```
int main (  
    int argc,  
    char ** argv )
```

Definition at line 31 of file main.cpp.

```
31     {  
32         menu();  
33     }  
34     if(mode == FOLLOW_MOUSE){  
35         mouseFollower mf;  
36         mf.initGL(&argc, argv);  
37     }  
38     else if(mode == STAY_IN_FIELD){  
39         prison pr;  
40         pr.initGL(&argc, argv);  
41     }  
42     else if(mode == IN_FLOW_FIELD){  
43         windy wnd;  
44         wnd.initGL(&argc, argv);  
45     }  
46     else if(mode == WANDER){  
47         wander wndr;  
48         wndr.initGL(&argc, argv);  
49     }  
50     else if(mode == PURSUIT){  
51         pursuit prs;  
52         prs.initGL(&argc, argv);  
53     }  
54     else if(mode == FLEE){  
55         flee fl;  
56         fl.initGL(&argc, argv);  
57     }  
58     else if(mode == EVADE){  
59         evade ev;  
60         ev.initGL(&argc, argv);  
61     }  
62     else if(mode == FLOCK){  
63         flock flc;  
64         flc.initGL(&argc, argv);  
65     }  
66     else if(mode == STAY_IN_PATH){  
67         pathFollower ptf;  
68         ptf.initGL(&argc, argv);  
69     }  
70     else if(mode == AVOID_OBSTACLE){  
71         obstacleAvoidance obst;  
72         obst.initGL(&argc, argv);  
73     }  
74     return 0;  
75 }  
76 }
```

Here is the call graph for this function:

6.22.1.2 menu()

```
void menu ( )
```

Definition at line 17 of file main.cpp.

```
17     {
18     cout << "Follow Mouse      : 1" << endl;
19     cout << "Stay in Field      : 2" << endl;
20     cout << "In Flow Field      : 3" << endl;
21     cout << "OBSTACLE AVOIDANCE : 4" << endl;
22     cout << "Stay in Path      : 5" << endl;
23     cout << "FLOCK              : 6" << endl;
24     cout << "WANDER             : 7" << endl;
25     cout << "FLEE              : 8" << endl;
26     cout << "PURSUIT           : 9" << endl;
27     cout << "EVADE            : 10" << endl;
28     cin >> mode;
29 }
```

Here is the caller graph for this function:

6.22.2 Variable Documentation

6.22.2.1 mode

```
int mode
```

Definition at line 15 of file main.cpp.

6.23 README.md File Reference

6.24 src/agent.cpp File Reference

```
#include "agent.h"
#include "pvector.h"
#include "graphics.h"
#include "random.h"
#include <iostream>
Include dependency graph for agent.cpp:
```

6.25 src/color.cpp File Reference

color class implementation

```
#include "color.h"
#include <vector>
Include dependency graph for color.cpp:
```

6.25.1 Detailed Description

color class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

13.05.2021

6.26 src/evade.cpp File Reference

```
#include "scenario.h"
#include "evade.h"
#include <iostream>
#include <GL/glut.h>
Include dependency graph for evade.cpp:
```

6.27 src/flee.cpp File Reference

```
#include "scenario.h"
#include "flee.h"
#include <iostream>
#include <GL/glut.h>
Include dependency graph for flee.cpp:
```

6.28 src/flock.cpp File Reference

```
#include "scenario.h"
#include "flock.h"
#include <iostream>
#include <GL/glut.h>
Include dependency graph for flock.cpp:
```

6.29 src/flowField.cpp File Reference

[flowField](#) class implementation

```
#include "flowField.h"
Include dependency graph for flowField.cpp:
```

6.29.1 Detailed Description

`flowField` class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

13.05.2021

6.30 src/graphics.cpp File Reference

```
#include "graphics.h"
#include <GL/glut.h>
#include <iostream>
#include "math.h"
Include dependency graph for graphics.cpp:
```

6.31 src/mouseFollower.cpp File Reference

```
#include "scenario.h"
#include "mouseFollower.h"
#include <iostream>
#include <GL/glut.h>
Include dependency graph for mouseFollower.cpp:
```

6.32 src/obstacle.cpp File Reference

obstacle class implementation

```
#include "obstacle.h"
#include "graphics.h"
#include "point.h"
#include <vector>
Include dependency graph for obstacle.cpp:
```

6.32.1 Detailed Description

obstacle class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

12.05.2021

6.33 src/obstacleAvoidance.cpp File Reference

```
#include "scenario.h"
#include "obstacleAvoidance.h"
#include <iostream>
#include <GL/glut.h>
Include dependency graph for obstacleAvoidance.cpp:
```

6.34 src/path.cpp File Reference

path class implementation

```
#include "path.h"
#include "graphics.h"
Include dependency graph for path.cpp:
```

6.34.1 Detailed Description

path class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

12.05.2021

6.35 src/pathFollower.cpp File Reference

```
#include "scenario.h"
#include "pathFollower.h"
#include <iostream>
#include <GL/glut.h>
Include dependency graph for pathFollower.cpp:
```

6.36 src/point.cpp File Reference

```
#include "point.h"
#include "pvector.h"
#include <string>
#include <iostream>
Include dependency graph for point.cpp:
```

6.37 src/prison.cpp File Reference

```
#include "scenario.h"
#include "prison.h"
#include <iostream>
#include <GL/glut.h>
Include dependency graph for prison.cpp:
```

6.38 src/pursuit.cpp File Reference

```
#include "scenario.h"
#include "pursuit.h"
#include <iostream>
#include <GL/glut.h>
Include dependency graph for pursuit.cpp:
```

6.39 src/pvector.cpp File Reference

```
#include "pvector.h"
#include "math.h"
#include "point.h"
#include <iostream>
#include <string>
Include dependency graph for pvector.cpp:
```

6.40 src/random.cpp File Reference

```
#include "random.h"
#include <stdlib.h>
#include <iostream>
Include dependency graph for random.cpp:
```

6.41 src/scenario.cpp File Reference

```
#include "scenario.h"
#include "random.h"
#include <iostream>
Include dependency graph for scenario.cpp:
```


6.42 src/steeringBehavior.cpp File Reference

```
#include "steeringBehavior.h"
#include "pvector.h"
#include "agent.h"
#include "path.h"
#include "point.h"
#include <vector>
#include "graphics.h"
#include "math.h"
#include "obstacle.h"
#include <iostream>
#include <GL/glut.h>
Include dependency graph for steeringBehavior.cpp:
```

6.43 src/wander.cpp File Reference

```
#include "scenario.h"
#include "wander.h"
#include <iostream>
#include <GL/glut.h>
Include dependency graph for wander.cpp:
```

6.44 src/windy.cpp File Reference

```
#include "scenario.h"
#include "windy.h"
#include <iostream>
#include <GL/glut.h>
Include dependency graph for windy.cpp:
```

6.45 test/test_suites.cpp File Reference

```
#include <boost/test/included/unit_test.hpp>
#include "../include/pvector.h"
#include "../include/point.h"
#include <iostream>
Include dependency graph for test_suites.cpp:
```

Macros

- `#define BOOST_TEST_MODULE test_suites`

Functions

- [BOOST_AUTO_TEST_CASE \(s1t1\)](#)
- [BOOST_AUTO_TEST_CASE \(s1t2\)](#)
- [BOOST_AUTO_TEST_CASE \(s1t3\)](#)
- [BOOST_AUTO_TEST_CASE \(s1t4\)](#)
- [BOOST_AUTO_TEST_CASE \(s1t5\)](#)
- [BOOST_AUTO_TEST_CASE \(s1t6\)](#)
- [BOOST_AUTO_TEST_CASE \(s1t7\)](#)
- [BOOST_AUTO_TEST_CASE \(s1t8\)](#)
- [BOOST_AUTO_TEST_CASE \(s1t9\)](#)
- [BOOST_AUTO_TEST_CASE \(s2t1\)](#)
- [BOOST_AUTO_TEST_CASE \(s2t2\)](#)
- [BOOST_AUTO_TEST_CASE \(s2t3\)](#)

6.45.1 Macro Definition Documentation

6.45.1.1 BOOST_TEST_MODULE

```
#define BOOST_TEST_MODULE test_suites
```

Definition at line 1 of file test_suites.cpp.

6.45.2 Function Documentation

6.45.2.1 BOOST_AUTO_TEST_CASE() [1/12]

```
BOOST_AUTO_TEST_CASE (
    s1t1 )
```

Definition at line 11 of file test_suites.cpp.

```
11     {
12         pvector p1 = pvector(0, 4);
13         pvector p2 = pvector(3, 0);
14         pvector p3 = p1 + p2;
15         BOOST_CHECK(p3.magnitude() == 5);
16     }
```

Here is the call graph for this function:

6.45.2.2 BOOST_AUTO_TEST_CASE() [2/12]

```
BOOST_AUTO_TEST_CASE (
    s1t2 )
```

Definition at line 17 of file test_suites.cpp.

```
17     {
18         pvector p1 = pvector(1, 1);
19         p1.mul(3);
20         pvector p2 = pvector(3, 3);
21         BOOST_CHECK(p1 == p2);
22     }
```

Here is the call graph for this function:

6.45.2.3 BOOST_AUTO_TEST_CASE() [3/12]

```
BOOST_AUTO_TEST_CASE (
    slt3 )
```

Definition at line 23 of file test_suites.cpp.

```
23     {
24         pvector p1 = pvector(5, 5);
25         p1.div(5);
26         pvector p2 = pvector(1, 1);
27         BOOST_CHECK(p1 == p2);
28     }
```

Here is the call graph for this function:

6.45.2.4 BOOST_AUTO_TEST_CASE() [4/12]

```
BOOST_AUTO_TEST_CASE (
    slt4 )
```

Definition at line 29 of file test_suites.cpp.

```
29     {
30         pvector p1 = pvector(1, 4);
31         pvector p2 = pvector(3, 2);
32         float dotProduct = p1.dotProduct(p2);
33         BOOST_CHECK(dotProduct == 11);
34     }
```

Here is the call graph for this function:

6.45.2.5 BOOST_AUTO_TEST_CASE() [5/12]

```
BOOST_AUTO_TEST_CASE (
    slt5 )
```

Definition at line 35 of file test_suites.cpp.

```
35     {
36         pvector p1 = pvector(10, 10);
37         pvector p2 = pvector(0, 10);
38         float angle = p1.angleBetween(p2);
39         BOOST_CHECK(angle == 45);
40     }
```

Here is the call graph for this function:

6.45.2.6 BOOST_AUTO_TEST_CASE() [6/12]

```
BOOST_AUTO_TEST_CASE (
    slt6 )
```

Definition at line 41 of file test_suites.cpp.

```
41     {
42         pvector p1 = pvector(3, 4);
43         float angle = p1.getAngle();
44         BOOST_CHECK(angle < 53.2 && angle > 52.8);
45     }
```

Here is the call graph for this function:

6.45.2.7 BOOST_AUTO_TEST_CASE() [7/12]

```
BOOST_AUTO_TEST_CASE (
    slt7 )
```

Definition at line 46 of file test_suites.cpp.

```
46      {
47          pvector p1 = pvector(2, 2);
48          p1.normalize();
49          float range = 0.01;
50          BOOST_CHECK_CLOSE_FRACTION(0.707, p1.x, range);
51          BOOST_CHECK_CLOSE_FRACTION(0.707, p1.y, range);
52      }
```

Here is the call graph for this function:

6.45.2.8 BOOST_AUTO_TEST_CASE() [8/12]

```
BOOST_AUTO_TEST_CASE (
    slt8 )
```

Definition at line 53 of file test_suites.cpp.

```
53      {
54          pvector p1 = pvector(2, 2);
55          p1.limit(3);
56          float range = 0.01;
57          BOOST_CHECK_CLOSE_FRACTION(2.12, p1.x, range);
58          BOOST_CHECK_CLOSE_FRACTION(2.12, p1.y, range);
59      }
```

Here is the call graph for this function:

6.45.2.9 BOOST_AUTO_TEST_CASE() [9/12]

```
BOOST_AUTO_TEST_CASE (
    slt9 )
```

Definition at line 60 of file test_suites.cpp.

```
60      {
61          pvector p1 = pvector(1, 1);
62          p1 += pvector(1, 1);
63          BOOST_CHECK(p1 == pvector(2, 2));
64          p1 = pvector(1, 1) + pvector(3, 3);
65          BOOST_CHECK(p1 == pvector(4, 4));
66          p1 = pvector(4, 1) - pvector(3, 3);
67          BOOST_CHECK(p1 == pvector(1, -2));
68          p1 = pvector(4, 1) - point(3, 3);
69          BOOST_CHECK(p1 == pvector(1, -2));
70          p1 = pvector(4, 1) + point(3, 3);
71          BOOST_CHECK(p1 == pvector(7, 4));
72      }
```

Here is the call graph for this function:

6.45.2.10 BOOST_AUTO_TEST_CASE() [10/12]

```
BOOST_AUTO_TEST_CASE (
    s2t1 )
```

Definition at line 76 of file test_suites.cpp.

```
76      {
77          point p1 = point(1, 1);
78          p1.mul(3);
79          point p2 = point(3, 3);
80          BOOST_CHECK(p1 == p2);
81      }
```

Here is the call graph for this function:

6.45.2.11 BOOST_AUTO_TEST_CASE() [11/12]

```
BOOST_AUTO_TEST_CASE (
    s2t2 )
```

Definition at line 82 of file test_suites.cpp.

```
82     {
83         point p1 = point (4, 4);
84         p1.div(4);
85         point p2 = point (1, 1);
86         BOOST_CHECK(p1 == p2);
87     }
```

Here is the call graph for this function:

6.45.2.12 BOOST_AUTO_TEST_CASE() [12/12]

```
BOOST_AUTO_TEST_CASE (
    s2t3 )
```

Definition at line 88 of file test_suites.cpp.

```
88     {
89         point p1 = point (1,1) + point (3,3);
90         BOOST_CHECK(p1 == point (4,4));
91         p1 = point (1,1) + pvector (3,3);
92         BOOST_CHECK(p1 == point (4,4));
93         pvector p2 = point (1,1) - point (3,3);
94         BOOST_CHECK(p2 == pvector (-2,-2));
95     }
```

Here is the call graph for this function:

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