

Autonomous Steering Agents

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Chapter 1

Intent

- 1- implementing ai using autonomous steering agents
- 2- implementing smart agents using genetics algorithms
- 3- implementing smart agents using 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

Jan Schiffmann : Nature of Code

Fernando Bevilacqua : Understanding Steering Behaviors

Jer Thorp : Living in Data

OpenGL :

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

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

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

Chapter 2

Todo List

Member `wander::wander ()`

business logic will be changed

Chapter 3

Hierarchical Index

3.1 Class Hierarchy

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

color	19
entity	22
agent	11
obstacle	41
path	46
flowField	29
graphics	31
point	50
pvector	59
random	68
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evade	25
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Chapter 4

Class Index

4.1 Class List

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

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evade	25
flee	26
flock	28
flowField	29
graphics	31
mouseFollower	40
obstacle	41
obstacleAvoidance	44
path	46
pathFollower	48
point	50
prison	56
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steeringBehavior	73
wander	82
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Chapter 5

File Index

5.1 File List

Here is a list of all files with brief descriptions:

main.cpp	Client code	120
include/ agent.h	Agent class defines all agent specifications	87
include/ color.h	Color class used for agent, path, wall etc. color	88
include/ entity.h	91
include/ evade.h	Evade class inherited from scenario class	92
include/ flee.h	Agents flee from mouse scenario	93
include/ flock.h	Flocking agents scenario	94
include/ flowField.h	FlowField class, screen can be filled with a force for each pixel	96
include/ graphics.h	Graphics class, drives openGL	98
include/ mouseFollower.h	Agents follow mouse scenario	100
include/ obstacle.h	Circular obstacles for agent avoidance behaviors	101
include/ obstacleAvoidance.h	Agents avoid from obstacles scenario	102
include/ path.h	Path class used for path following steering behaviors	104
include/ pathFollower.h	Path following scenario	105
include/ point.h	Point class used for point operations	106
include/ prison.h	Agents cant escape from field scenario	108
include/ pursuit.h	One agent pursue other one scenario	109
include/ pvector.h	Pvector class used for 2D vector operations	110

include/random.h	Utility class for random operations	112
include/scenario.h	Base class for all scenarios	112
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include/wander.h	Random wandering agents scenario	118
include/windy.h	Windy air scenario	119
src/agent.cpp	Implementation of the agent class	123
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src/flee.cpp	Flee class implementation	126
src/flock.cpp	Flock class implementation	127
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src/graphics.cpp	Graphics class implementation	129
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src/path.cpp	Path class implementation	133
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src/point.cpp	Point class implementation file	135
src/prison.cpp	Prison class implementation	136
src/pursuit.cpp	Prison class implementation	138
src/pvector.cpp	Pvector class implementation	139
src/random.cpp	Utility class for random operations	140
src/scenario.cpp	Scenario base class implementation	140
src/steeringBehavior.cpp	Implementation of autonomous steering behaviors	142
src/wander.cpp	Wander class implementation	143
src/windy.cpp	Windy class implementation	144
test/test_suites.cpp	Unit test suites	145

Chapter 6

Class Documentation

6.1 agent Class Reference

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

Public Member Functions

- `agent ()`
default constructor.
- `agent (float x, float y)`
constructor.
- `~agent ()`
destructor
- `void updatePosition (bool arrive)`
position update calculations
- `void setFeatures (float s, float f, float r, float m)`
initialize the agent attributes
- `string getName ()`
name attribute getter
- `void setName (string n)`
name attribute setter
- `float getMass ()`
mass attribute getter
- `void setMass (float m)`
mass attribute setter
- `void draw (graphics view) override`
agent drawing

Public Attributes

- [point position](#)
position of the agent
- [pvector velocity](#)
velocity of the agent
- [point targetPoint](#)
target of the agent
- float [maxSpeed](#)
maximum speed of the agent
- float [maxForce](#)
maximum force of the agent
- [pvector steering](#)
steering force of the apply
- [pvector force](#)
force of the agent
- [pvector acceleration](#)
acceleration of the agent
- [pvector desiredVelocity](#)
desired velocity of the agent
- float [r](#)
radius of the agent
- int [id](#)
id of the agent
- bool [arrive](#) = false
has arriving behavior or not

6.1.1 Detailed Description

Definition at line 21 of file agent.h.

6.1.2 Constructor & Destructor Documentation

6.1.2.1 [agent\(\)](#) [1/2]

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

default constructor.

See also

[agent\(float x, float y\)](#)

Definition at line 16 of file agent.cpp.

```
17 {  
18  
19 }
```


6.1.2.2 agent() [2/2]

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

constructor.

Parameters

<i>x</i>	position x of the agent
<i>y</i>	position y of the agent

See also[agent\(\)](#)

Definition at line 37 of file agent.cpp.

```

38 {
39     position      = point(x, y);
40     velocity      = pvector(0.6, 0.0);
41     acceleration  = pvector(0.0, 0.0);
42     steering      = pvector(0.0, 0.0);
43     desiredVelocity = pvector(0.0, 0.0);
44     force         = pvector(0.0, 0.0);
45     targetPoint   = point(0.0, 0.0);
46     entityColor   = RED;
47 }
```

6.1.2.3 ~agent()

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

destructor

Definition at line 78 of file agent.cpp.

```

79 {
80
81 }
```

6.1.3 Member Function Documentation**6.1.3.1 draw()**

```
void agent::draw (
    graphics view ) [override], [virtual]
```

agent drawing

Parameters

<i>view</i>	graphics to draw
-------------	------------------

Implements [entity](#).

Definition at line 83 of file agent.cpp.

```
83     {
84         this->updatePosition(this->arrive);
85         view.drawAgent(*this);
86     }
```

6.1.3.2 getMass()

```
float agent::getMass ( )
```

mass attribute getter

Definition at line 29 of file agent.cpp.

```
29     {
30         return mass;
31     }
```

6.1.3.3 getName()

```
string agent::getName ( )
```

name attribute getter

Definition at line 21 of file agent.cpp.

```
21     {
22         return name;
23     }
```

6.1.3.4 setFeatures()

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

initialize the agent attributes

Parameters

<i>s</i>	maximum velocity
<i>f</i>	maximum force
<i>r</i>	radius for arriving behavior
<i>m</i>	mass

Definition at line 70 of file agent.cpp.

```
71 {
72     this->maxSpeed = s;
73     this->maxForce = f;
```

```
74     this->r = r;  
75     this->mass = m;  
76 }
```

6.1.3.5 setMass()

```
void agent::setMass (  
    float m )
```

mass attribute setter

Parameters

<i>m</i>	set value
----------	-----------

Definition at line 33 of file agent.cpp.

```
33     {  
34         mass = m;  
35     }
```

6.1.3.6 setName()

```
void agent::setName (  
    string n )
```

name attribute setter

Parameters

<i>n</i>	set value
----------	-----------

Definition at line 25 of file agent.cpp.

```
25     {  
26         name = n;  
27     }
```

6.1.3.7 updatePosition()

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

position update calculations

Parameters

<i>arrive</i>	has arriving behavior or not
---------------	------------------------------

See also

[agent\(\)](#)

Definition at line 49 of file agent.cpp.

```
50 {
51     force.limit(maxForce);
52     acceleration = force;
53     velocity += acceleration;
54
55     //arriving behavior implementation
56     if(arrive == true){
57         pvector diff = targetPoint - position;
58         if(diff.magnitude() > r)
59             velocity.limit(maxSpeed);
60         else
61             velocity.limit(maxSpeed * diff.magnitude() / r);
62     }
63     else
64         velocity.limit(maxSpeed);
65
66     position = position + velocity;
67     force = pvector(0,0);
68 }
```

6.1.4 Member Data Documentation

6.1.4.1 acceleration

`pvector agent::acceleration`

acceleration of the agent

Definition at line 124 of file agent.h.

6.1.4.2 arrive

`bool agent::arrive = false`

has arriving behavior or not

Definition at line 144 of file agent.h.

6.1.4.3 desiredVelocity

`pvector agent::desiredVelocity`

desired velocity of the agent

Definition at line 129 of file agent.h.

6.1.4.4 force

```
pvector agent::force
```

force of the agent

Definition at line 119 of file agent.h.

6.1.4.5 id

```
int agent::id
```

id of the agent

Definition at line 139 of file agent.h.

6.1.4.6 maxForce

```
float agent::maxForce
```

maximum force of the agent

Definition at line 109 of file agent.h.

6.1.4.7 maxSpeed

```
float agent::maxSpeed
```

maximum speed of the agent

Definition at line 104 of file agent.h.

6.1.4.8 position

```
point agent::position
```

position of the agent

Definition at line 89 of file agent.h.

6.1.4.9 r

```
float agent::r
```

radius of the agent

Definition at line 134 of file agent.h.

6.1.4.10 steering

```
pvector agent::steering
```

steering force of the apply

Definition at line 114 of file agent.h.

6.1.4.11 targetPoint

```
point agent::targetPoint
```

target of the agent

Definition at line 99 of file agent.h.

6.1.4.12 velocity

```
pvector agent::velocity
```

velocity of the agent

Definition at line 94 of file agent.h.

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

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

6.2 color Class Reference

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

Public Member Functions

- [color](#) ()
default constructor.
- [color](#) (float r, float g, float b)
constructor.

Static Public Member Functions

- static [color](#) [getColor](#) (int index)
gets colorbar colors

Public Attributes

- float [R](#)
portion of red color
- float [G](#)
portion of green color
- float [B](#)
portion of blue color

6.2.1 Detailed Description

Definition at line 23 of file color.h.

6.2.2 Constructor & Destructor Documentation

6.2.2.1 [color\(\)](#) [1/2]

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

default constructor.

See also

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

Definition at line 13 of file color.cpp.

```
14 {  
15  
16 }
```

6.2.2.2 [color\(\)](#) [2/2]

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

constructor.

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 19 of file color.cpp.

```
20 {  
21     R = r;  
22     G = g;  
23     B = b;  
24 }
```

6.2.3 Member Function Documentation

6.2.3.1 getColor()

```
color color::getColor (  
    int index ) [static]
```

gets colorbar colors

Parameters

<i>index</i>	color id
--------------	----------

Definition at line 26 of file color.cpp.

```
26 {  
27     switch (index)  
28     {  
29         case 0: return WHITE; break;  
30         case 1: return BLUE; break;  
31         case 2: return RED; break;  
32         case 3: return YELLOW; break;  
33         case 4: return GREEN; break;  
34         case 5: return BLACK; break;  
35         case 6: return CYAN; break;  
36         case 7: return MAGENDA; break;  
37     }  
38     return RED;  
39 }  
40 }
```

6.2.4 Member Data Documentation

6.2.4.1 B

```
float color::B
```

portion of blue color

Definition at line 53 of file color.h.

6.2.4.2 G

```
float color::G
```

portion of green color

Definition at line 48 of file color.h.

6.2.4.3 R

```
float color::R
```

portion of red color

Definition at line 43 of file color.h.

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

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

6.3 entity Class Reference

```
#include <entity.h>
```

Public Member Functions

- [entity](#) ()
default constructor.
- string [getName](#) ()
getter of the name
- void [setName](#) (string name)
name attribute setter
- int [getId](#) ()
getter of the id attribute
- void [setId](#) (int id)
id attribute setter
- virtual void [draw](#) ([graphics](#) view)=0
overriden by child classes

Public Attributes

- [color](#) `entityColor`
color of the entity

6.3.1 Detailed Description

Definition at line 10 of file `entity.h`.

6.3.2 Constructor & Destructor Documentation

6.3.2.1 `entity()`

```
entity::entity ( )
```

default constructor.

Definition at line 10 of file `entity.cpp`.

```
10         {  
11     entityColor = RED;  
12 }
```

6.3.3 Member Function Documentation

6.3.3.1 `draw()`

```
virtual void entity::draw (  
    graphics view ) [pure virtual]
```

overridden by child classes

Parameters

<code>view</code>	<code>graphics</code>
-------------------	-----------------------

Implemented in [agent](#), [obstacle](#), and [path](#).

6.3.3.2 `getId()`

```
int entity::getId ( )
```

getter of the id attribute

Definition at line 22 of file entity.cpp.

```
22         {  
23     return id;  
24 }
```

6.3.3.3 getName()

```
string entity::getName ( )
```

getter of the name

Definition at line 14 of file entity.cpp.

```
14         {  
15     return name;  
16 }
```

6.3.3.4 setId()

```
void entity::setId (  
    int id )
```

id attribute setter

Parameters

<i>id</i>	setter
-----------	--------

Definition at line 26 of file entity.cpp.

```
26         {  
27     this->id = id;  
28 }
```

6.3.3.5 setName()

```
void entity::setName (  
    string name )
```

name attribute setter

Parameters

<i>name</i>	setter
-------------	--------

Definition at line 18 of file entity.cpp.

```
18 {
```

```
19     this->name = name;  
20 }
```

6.3.4 Member Data Documentation

6.3.4.1 entityColor

`color` `entity::entityColor`

color of the entity

Definition at line 48 of file `entity.h`.

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

- `include/entity.h`
- `src/entity.cpp`

6.4 evade Class Reference

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

Public Member Functions

- `evade ()`
default constructor.

Static Public Member Functions

- static void `loop ()`
loop function of evading scenario

Additional Inherited Members

6.4.1 Detailed Description

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

6.4.2 Constructor & Destructor Documentation

6.4.2.1 evade()

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

default constructor.

Definition at line 31 of file evade.cpp.

```
32 {
33     name = "evading";
34     createAgent(STATIC, nullptr, nullptr, nullptr);
35     callback = reinterpret_cast <void(*)()> ( (void *)(&loop) );
36 }
```

6.4.3 Member Function Documentation

6.4.3.1 loop()

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

loop function of evading scenario

Note

opengl callback forces that function to be static

Definition at line 15 of file evade.cpp.

```
16 {
17     for(auto it = agents.begin(); it < agents.end(); it++){
18         if((*it).getName() == "lion"){
19             (*it).targetPoint = view.getMousePosition();
20             (*it).force = behavior.seek(*it);
21             (*it).arrive = true;
22         }
23         else{//gazelle
24             (*it).force = behavior.evade(agents, *it, view, "lion");
25         }
26     }
27     refresh();
28 }
29 }
```

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

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

6.5 flee Class Reference

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

Public Member Functions

- [flee \(\)](#)
default constructor.

Static Public Member Functions

- static void [loop](#) ()
evading scenario loop function

Additional Inherited Members

6.5.1 Detailed Description

Definition at line 14 of file flee.h.

6.5.2 Constructor & Destructor Documentation

6.5.2.1 flee()

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

default constructor.

Definition at line 24 of file flee.cpp.

```
25 {  
26     int agentCount = 196;  
27     name = "fleeing troop";  
28     createAgent(TROOP, &agentCount, nullptr, nullptr);  
29     callback = reinterpret_cast <void(*)()> ( (void *)(&loop) );  
30 }
```

6.5.3 Member Function Documentation

6.5.3.1 loop()

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

evading scenario loop function

Note

opengl callback forces that function to be static

Definition at line 15 of file flee.cpp.

```
16 {  
17     for(auto it = agents.begin(); it < agents.end(); it++){  
18         (*it).force = behavior.flee((*it), view, view.getMousePosition());  
19     }  
20  
21     refresh();  
22 }
```

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

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

6.6 flock Class Reference

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

Public Member Functions

- [flock](#) ()
default constructor.

Static Public Member Functions

- static void [loop](#) ()
flocking scenario loop function

Additional Inherited Members

6.6.1 Detailed Description

Definition at line 15 of file flock.h.

6.6.2 Constructor & Destructor Documentation

6.6.2.1 flock()

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

default constructor.

Definition at line 36 of file flock.cpp.

```
37 {  
38     int agentCount = 50;  
39     float maxForce = 0.3;  
40     float maxSpeed = 0.8;  
41     name = "flocking agents";  
42     createAgent(RANDOM, &agentCount, &maxForce, &maxSpeed);  
43     callback = reinterpret_cast <void(*)()> ( (void *)(&loop) );  
44 }
```

6.6.3 Member Function Documentation

6.6.3.1 loop()

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

flocking scenario loop function

Note

opengl callback forces that function to be static

Definition at line 15 of file flock.cpp.

```
16 {
17     for(auto it = agents.begin(); it < agents.end(); it++){
18         view.forceInScreen((*it));
19
20         pvector sep = behavior.separation(agents, *it);
21         sep.mul(1.5);
22         pvector ali = behavior.align(agents, *it);
23         ali.mul(4);
24         pvector coh = behavior.cohesion(agents, *it);
25         coh.mul(0.1);
26
27         (*it).force = sep + ali + coh;
28         (*it).desiredVelocity = (*it).force + (*it).velocity;
29         (*it).targetPoint = (*it).position + (*it).desiredVelocity;
30         (*it).arrive = true;
31     }
32
33     refresh();
34 }
```

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

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

6.7 flowField Class Reference

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

Public Member Functions

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

6.7.1 Detailed Description

Definition at line 18 of file flowField.h.

6.7.2 Constructor & Destructor Documentation

6.7.2.1 flowField() [1/2]

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

default constructor.

See also

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

Definition at line 15 of file flowField.cpp.

```
16 {  
17  
18 }
```

6.7.2.2 flowField() [2/2]

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

constructor.

Parameters

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

See also

[flowField\(\)](#)

Definition at line 10 of file flowField.cpp.

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

6.7.3 Member Function Documentation

6.7.3.1 getField()

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

get force at individual pixel

Parameters

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

Returns

force at specified position

Definition at line 39 of file flowField.cpp.

```
40 {
41     return uniformField[x][y];
42 }
```

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

- include/flowField.h
- src/flowField.cpp

6.8 graphics Class Reference

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

Public Member Functions

- void [drawAgent](#) ([agent](#) &[agent](#))
drawing with corresponding angle
- void [drawLine](#) ([point](#) p1, [point](#) p2, [color](#) cl)
drawing line
- void [drawPath](#) ([path](#) &[path](#))
draws path
- void [drawPoint](#) ([point](#) p)
draws point
- void [drawCircle](#) ([point](#) p, float radius, [color](#) color)
draws circle
- void [drawText](#) (string text, [point](#) p)
draws text on screen
- void [forceInScreen](#) ([agent](#) &[agent](#))
changes agent position so that it stays in screen
- void [refreshScene](#) ()
update agent position
- [point](#) [getMousePosition](#) ()
gets mouse position
- void [initGraphics](#) (int *argv, char **argc, void(*callback)())
initialization of graphics

Static Public Member Functions

- static void `timerEvent` (int value)
periodic timer event
- static void `handleKeyPress` (unsigned char key, int x, int y)
key press event
- static void `mouseButton` (int button, int state, int x, int y)
mouse press event
- static void `handleResize` (int w, int h)
event triggered with screen resizing
- static void `mouseMove` (int x, int y)
event triggered with mouse movements

Static Public Attributes

- static int `target_x` = `-WIDTH`
mouse position x
- static int `target_y` = `HEIGHT`
mouse position y

6.8.1 Detailed Description

Definition at line 22 of file `graphics.h`.

6.8.2 Member Function Documentation

6.8.2.1 `drawAgent()`

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

drawing with corresponding angle

Parameters

<i>agent</i>	instance to change
--------------	--------------------

Definition at line 159 of file `graphics.cpp`.

```
160 {
161     glPushMatrix();
162     glTranslatef(agent.position.x, agent.position.y, 0.0f);
163     glRotatef(agent.velocity.getAngle(), 0.0f, 0.0f, 1.0f);
164     glBegin(GL_TRIANGLES);
165     glColor3f( agent.entityColor.R, agent.entityColor.G, agent.entityColor.B);
166     glVertex3f( 1.0f, 0.0f, 0.0f);
167     glVertex3f(-1.0f, 0.5f, 0.0f);
168     glVertex3f(-1.0f, -0.5f, 0.0f);
169     glEnd();
170     glPopMatrix();
```

```
171 }
```

6.8.2.2 drawCircle()

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

draws circle

Parameters

<i>p</i>	center of the circle
<i>radius</i>	radius of the circle
<i>color</i>	of the circle

Definition at line 136 of file graphics.cpp.

```
137 {
138     glColor3f(color.R, color.G, color.B);
139     glBegin(GL_LINE_STRIP);
140     glLineWidth(2);
141     for (int i = 0; i <= 300; i++) {
142         float angle = 2 * PI * i / 300;
143         float x = cos(angle) * radius;
144         float y = sin(angle) * radius;
145         glVertex2d(p.x + x, p.y + y);
146     }
147     glEnd();
148 }
```

6.8.2.3 drawLine()

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

drawing line

Parameters

<i>p1</i>	start point of the line
<i>p2</i>	end point of the line
<i>color</i>	of the line

Definition at line 126 of file graphics.cpp.

```
127 {
128     glColor3f( cl.R, cl.G, cl.B);
129     glLineWidth(2);
130     glBegin(GL_LINES);
131     glVertex2f(p1.x, p1.y);
132     glVertex2f(p2.x, p2.y);
```

```

133     glEnd();
134 }

```

6.8.2.4 drawPath()

```

void graphics::drawPath (
    path & path )

```

draws path

Parameters

<i>path</i>	to draw
-------------	---------

Definition at line 112 of file graphics.cpp.

```

113 {
114     point p1, p2;
115     for(auto it = path.points.begin(); it < path.points.end()-1; it++){
116         p1 = point((*it).x, (*it).y - path.width/2) ;
117         p2 = point((*it+1).x, (*it+1).y - path.width/2);
118         drawLine(p1, p2, path.entityColor);
119
120         p1 = point((*it).x, (*it).y + path.width/2) ;
121         p2 = point((*it+1).x, (*it+1).y + path.width/2);
122         drawLine(p1, p2, path.entityColor);
123     }
124 }

```

6.8.2.5 drawPoint()

```

void graphics::drawPoint (
    point p )

```

draws point

Parameters

<i>p</i>	point to draw
----------	---------------

Definition at line 150 of file graphics.cpp.

```

151 {
152     glColor3f(1,1,1);
153     glPointSize(4.0);
154     glBegin(GL_POINTS);
155     glVertex2f(p.x, p.y);
156     glEnd();
157 }

```

6.8.2.6 drawText()

```

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

```

draws text on screen

Parameters

<i>p</i>	position of the text
<i>text</i>	to display

Definition at line 21 of file graphics.cpp.

```

22 {
23     glColor3f (0.0, 0.0, 1.0);
24     glRasterPos2f(p.x, p.y);
25     for ( string::iterator it=text.begin(); it!=text.end(); ++it){
26         glutBitmapCharacter(GLUT_BITMAP_9_BY_15, *it);
27     }
28 }
```

6.8.2.7 forceInScreen()

```

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

changes agent position so that it stays in screen

Parameters

<i>agent</i>	instance
--------------	----------

Definition at line 61 of file graphics.cpp.

```

62 {
63     if (agent.position.x > WIDTH)
64         agent.position.x -= 2 * WIDTH;
65     if (agent.position.x < -WIDTH)
66         agent.position.x += 2 * WIDTH;
67     if (agent.position.y > HEIGHT)
68         agent.position.y -= 2 * HEIGHT;
69     if (agent.position.y < -HEIGHT)
70         agent.position.y += 2 * HEIGHT;
71 }
```

6.8.2.8 getMousePosition()

```

point graphics::getMousePosition ( )
```

gets mouse position

Returns

mouse point

Definition at line 56 of file graphics.cpp.

```

57 {
58     return point (graphics::target_x, graphics::target_y);
59 }
```

6.8.2.9 handleKeypress()

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

key press event

Parameters

<i>key</i>	pressed
<i>x</i>	unused but required for OpenGL
<i>y</i>	unused but required for OpenGL

Definition at line 105 of file graphics.cpp.

```
106 {
107     if (key == ESC){
108         exit(0);
109     }
110 }
```

6.8.2.10 handleResize()

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

event triggered with screen resizing

Parameters

<i>w</i>	width of the screen
<i>h</i>	height of the screen

Definition at line 81 of file graphics.cpp.

```
82 {
83     glViewport(0, 0, w, h); //Tell OpenGL how to convert from coordinates to pixel values
84     glMatrixMode(GL_PROJECTION); //Switch to setting the camera perspective
85     glLoadIdentity(); //Reset the camera
86     //Set the camera perspective
87     gluPerspective(45.0, //The camera angle
88                   (double)w / (double)h, //The width-to-height ratio
89                   1.0, //The near z clipping coordinate
90                   200.0); //The far z clipping coordinate
91 }
```

6.8.2.11 initGraphics()

```
void graphics::initGraphics (
    int * argv,
```



```
char ** argc,  
void(*)() callback )
```

initialization of graphics

Parameters

<i>argv</i>	user parameters
<i>argc</i>	count of user parameters
<i>callback</i>	loop function for openGL periodic callback

Definition at line 39 of file graphics.cpp.

```

40 {
41     glutInit(argv, argc);
42     glutInitDisplayMode(GLUT_DOUBLE | GLUT_RGB | GLUT_DEPTH);
43     glutInitWindowSize(400, 400);
44     glutCreateWindow("Autonomous Steering Agents");
45     glClearColor(0.7f, 0.7f, 0.7f, 1.0f); //set background color
46     glEnable(GL_DEPTH_TEST);
47     glutDisplayFunc(*callback);
48     glutMouseFunc(graphics::mouseButton);
49     glutPassiveMotionFunc(graphics::mouseMove);
50     glutKeyboardFunc(graphics::handleKeypress);
51     glutReshapeFunc(graphics::handleResize);
52     glutTimerFunc(20, graphics::timerEvent, 0);
53     glutMainLoop();
54 }
```

6.8.2.12 mouseButton()

```

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

mouse press event

Parameters

<i>button</i>	mouse key pressed
<i>state</i>	down/up etc.
<i>x</i>	unused but required for openGL
<i>y</i>	unused but required for openGL

Definition at line 99 of file graphics.cpp.

```

100 {
101     if (button == GLUT_LEFT_BUTTON && state == GLUT_DOWN){
102     }
103 }
```

6.8.2.13 mouseMove()

```

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

event triggered with mouse movements

Parameters

<i>x</i>	osition of the mouse
<i>y</i>	position of the mouse

Definition at line 73 of file graphics.cpp.

```

74 {
75     //TODO: mouse position to glut
76     //TODO: magic numbers
77     graphics::target_x = x / 5.88 - 34;
78     graphics::target_y = 34 - y / 5.88;
79 }
```

6.8.2.14 refreshScene()

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

update agent position

Definition at line 30 of file graphics.cpp.

```

31 {
32     glutSwapBuffers();
33     glClear(GL_COLOR_BUFFER_BIT | GL_DEPTH_BUFFER_BIT);
34     glMatrixMode(GL_MODELVIEW); //Switch to the drawing perspective
35     glLoadIdentity(); //Reset the drawing perspective
36     glTranslatef(0.0f, 0.0f, -85.0f); //Move to the center of the triangle
37 }
```

6.8.2.15 timerEvent()

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

periodic timer event

Parameters

<i>value</i>	period as ms
--------------	--------------

Definition at line 93 of file graphics.cpp.

```

94 {
95     glutPostRedisplay(); //Tell GLUT that the display has changed
96     glutTimerFunc(value, timerEvent, 20);
97 }
```

6.8.3 Member Data Documentation

6.8.3.1 target_x

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

mouse position x

Definition at line 130 of file graphics.h.

6.8.3.2 target_y

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

mouse position y

Definition at line 135 of file graphics.h.

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

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

6.9 mouseFollower Class Reference

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

Public Member Functions

- [mouseFollower](#) ()
default constructor.

Static Public Member Functions

- static void [loop](#) ()
mouse following scenario loop function

Additional Inherited Members

6.9.1 Detailed Description

Definition at line 14 of file mouseFollower.h.

6.9.2 Constructor & Destructor Documentation

6.9.2.1 mouseFollower()

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

default constructor.

Definition at line 25 of file mouseFollower.cpp.

```
26 {
27     int agentCount = 30;
28     float maxForce = 0.3;
29     float maxSpeed = 0.6;
30     name = "mouse following";
31     createAgent(RANDOM, &agentCount, &maxForce, &maxSpeed);
32     callback = reinterpret_cast<void(*)()> ( (void *)(&loop) );
33 }
```

6.9.3 Member Function Documentation

6.9.3.1 loop()

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

mouse following scenario loop function

Note

opengl callback forces that function to be static

Definition at line 15 of file mouseFollower.cpp.

```
16 {
17     for(auto it = agents.begin(); it < agents.end(); it++){
18         (*it).targetPoint = view.getMousePosition();
19         (*it).force = behavior.seek(*it);
20         (*it).arrive = true;
21     }
22     refresh();
23 }
```

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

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

6.10 obstacle Class Reference

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

Public Member Functions

- [obstacle \(\)](#)
default constructor.
- [obstacle \(point p, float r\)](#)
constructor
- void [draw \(graphics view\)](#) override
overriden draw implementation

Public Attributes

- [point p](#)
center point of the obstacle
- [float r](#)
radius of the obstacle

6.10.1 Detailed Description

Definition at line 15 of file obstacle.h.

6.10.2 Constructor & Destructor Documentation

6.10.2.1 `obstacle()` [1/2]

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

default constructor.

See also

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

Definition at line 16 of file obstacle.cpp.

```
17 {
18     p = point(0,0);
19     r = 5;
20     entityColor = RED;
21 }
```

6.10.2.2 `obstacle()` [2/2]

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

constructor

Parameters

<i>p</i>	center of the circular obstacle
<i>r</i>	radius of the obstacle

See also

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

Definition at line 23 of file obstacle.cpp.

```
24 {  
25     this->p = p;  
26     this->r = r;  
27     entityType = RED;  
28 }
```

6.10.3 Member Function Documentation

6.10.3.1 draw()

```
void obstacle::draw (  
    graphics view ) [override], [virtual]
```

overridden draw implementation

Implements [entity](#).

Definition at line 30 of file obstacle.cpp.

```
30     {  
31         view.drawCircle(p, r, entityType);  
32     }
```

6.10.4 Member Data Documentation

6.10.4.1 p

[point](#) obstacle::p

center point of the obstacle

Definition at line 34 of file obstacle.h.

6.10.4.2 r

[float](#) obstacle::r

radius of the obstacle

Definition at line 39 of file obstacle.h.

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

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

6.11 obstacleAvoidance Class Reference

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

Public Member Functions

- [obstacleAvoidance](#) ()
default constructor.

Static Public Member Functions

- static void [loop](#) ()
obstacle avoidance scenario loop function
- static void [createObstacle](#) (vector< [obstacle](#) > &[obstacles](#))
creation of list of obstacles

Static Public Attributes

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

Additional Inherited Members

6.11.1 Detailed Description

Definition at line 15 of file obstacleAvoidance.h.

6.11.2 Constructor & Destructor Documentation

6.11.2.1 obstacleAvoidance()

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

default constructor.

Definition at line 42 of file obstacleAvoidance.cpp.

```
43 {
44     name = "avoid obstacles";
45     createAgent(STATIC, nullptr, nullptr, nullptr);
46     createObstacle(obstacles);
47     callback = reinterpret_cast <void(*)()> ( (void *)(&loop) );
48 }
```

6.11.3 Member Function Documentation

6.11.3.1 createObstacle()

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

creation of list of obstacles

Parameters

<i>obstacles</i>	list to be created
------------------	--------------------

Note

opengl callback forces that function to be static

Definition at line 35 of file obstacleAvoidance.cpp.

```

36 {
37     obstacles.push_back(obstacle(point(0,0), 8));
38     obstacles.push_back(obstacle(point(-20,0), 3));
39     obstacles.push_back(obstacle(point(20,-10), 4));
40 }
```

6.11.3.2 loop()

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

obstacle avoidance scenario loop function

Note

opengl callback forces that function to be static

Definition at line 17 of file obstacleAvoidance.cpp.

```

18 {
19     for(auto it = agents.begin(); it < agents.end(); it++){
20         (*it).targetPoint = view.getMousePosition();
21         pvector seek = behavior.seek(*it);
22         seek.mul(0.5);
23
24         pvector avoid = behavior.avoid(obstacles, *it);
25         (*it).force = avoid + seek;
26         (*it).arrive = true;
27
28         for(auto it = obstacles.begin(); it < obstacles.end(); it++){
29             (*it).draw(view);
30         }
31     }
32     refresh();
33 }
```

6.11.4 Member Data Documentation

6.11.4.1 obstacles

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

list of obstacles

Note

opengl callback forces that function to be static

Definition at line 32 of file obstacleAvoidance.h.

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

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

6.12 path Class Reference

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

Public Member Functions

- [path](#) ()
default constructor.
- [path](#) (float [width](#))
donstructor.
- void [addPoint](#) ([point](#) p)
adds a new point to the path
- void [draw](#) ([graphics](#) view)
overriden draw implementation

Public Attributes

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

6.12.1 Detailed Description

Definition at line 17 of file path.h.

6.12.2 Constructor & Destructor Documentation

6.12.2.1 [path\(\)](#) [1/2]

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

default constructor.

See also

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

Definition at line 16 of file path.cpp.

```
17 {  
18     entityColor = BLUE;  
19     width = 8;  
20 }
```

6.12.2.2 [path\(\)](#) [2/2]

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

donstructor.

Parameters

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

See also

[path\(\)](#)

Definition at line 22 of file path.cpp.

```
23 {  
24     this->width = width;  
25     entityColor = BLUE;  
26 }
```

6.12.3 Member Function Documentation

6.12.3.1 addPoint()

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

adds a new point to the path

Parameters

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

Definition at line 11 of file path.cpp.

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

6.12.3.2 draw()

```
void path::draw (  
    graphics view ) [virtual]
```

overriden draw implementation

Implements [entity](#).

Definition at line 28 of file path.cpp.

```
28     {  
29     view.drawPath(*this);  
30 }
```

6.12.4 Member Data Documentation

6.12.4.1 points

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

list of points added to the path

Definition at line 41 of file path.h.

6.12.4.2 width

```
int path::width
```

width of the path

Definition at line 46 of file path.h.

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

- include/path.h
- src/path.cpp

6.13 pathFollower Class Reference

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

Public Member Functions

- [pathFollower \(\)](#)
default constructor.

Static Public Member Functions

- static void [loop \(\)](#)
path follower scenario loop function
- static void [createPath \(path &p\)](#)
creates path

Static Public Attributes

- static [path myPath](#)
path that will be followed

Additional Inherited Members

6.13.1 Detailed Description

Definition at line 14 of file pathFollower.h.

6.13.2 Constructor & Destructor Documentation

6.13.2.1 pathFollower()

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

default constructor.

Definition at line 38 of file pathFollower.cpp.

```
39 {
40     int agentCount = 40;
41     float maxForce = 0.2;
42     float maxSpeed = 0.4;
43     myPath = path(8);
44     createPath(myPath);
45     name = "path following";
46     createAgent(RANDOM, &agentCount, &maxForce, &maxSpeed);
47     callback = reinterpret_cast<void(*)()> ( (void *)(&loop) );
48 }
```

6.13.3 Member Function Documentation

6.13.3.1 createPath()

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

creates path

Parameters

<i>path</i>	to create
-------------	-----------

Note

opengl callback forces that function to be static

Definition at line 30 of file pathFollower.cpp.

```
31 {
32     p.addPoint(point(-40, 5));
33     p.addPoint(point(-14, 15));
```

```

34     p.addPoint(point( 10, 7));
35     p.addPoint(point( 40, 12));
36 }

```

6.13.3.2 loop()

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

path follower scenario loop function

Note

opengl callback forces that function to be static

Definition at line 17 of file pathFollower.cpp.

```

18 {
19     for(auto it = agents.begin(); it < agents.end(); it++){
20         pvector flwpth = behavior.stayInPath(*it, myPath, view);
21         pvector sep = behavior.separation(agents, *it);
22         sep.mul(5);
23         (*it).force = sep + flwpth;
24     }
25     myPath.draw(view);
26 }
27 refresh();
28 }

```

6.13.4 Member Data Documentation

6.13.4.1 myPath

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

path that will be followed

Note

opengl callback forces that function to be static

Definition at line 38 of file pathFollower.h.

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

- include/pathFollower.h
- src/pathFollower.cpp

6.14 point Class Reference

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

Public Member Functions

- [point](#) ()
default constructor
- [point](#) (float [x](#), float [y](#))
constructor
- void [div](#) (float [d](#))
divide point
- void [mul](#) (float [d](#))
multiply point
- void [print](#) (const string &[s](#))
debug function
- void [getNormalPoint](#) ([point](#) [predicted](#), [point](#) [start](#), [point](#) [end](#))
provides normal point on a vector of a point
- [point operator+](#) ([pvector](#) const &[obj](#))
overloaded + operator
- [point operator+](#) ([point](#) const &[obj](#))
overloaded + operator
- [pvector operator-](#) ([point](#) const &[obj](#))
overloaded - operator
- bool [operator==](#) ([point](#) const &[obj](#))
overloaded == operator

Public Attributes

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

6.14.1 Detailed Description

Definition at line 15 of file [point.h](#).

6.14.2 Constructor & Destructor Documentation

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

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

default constructor

See also

[point\(float x, float y\)](#)

Definition at line 21 of file [point.cpp](#).

```
22 {  
23     x = 0;  
24     y = 0;  
25 }
```

6.14.2.2 point() [2/2]

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

constructor

Parameters

<i>x</i>	position x of the point
<i>y</i>	position y of the point

See also

[point\(\)](#)

Definition at line 15 of file point.cpp.

```
16 {
17     this->x = x;
18     this->y = y;
19 }
```

6.14.3 Member Function Documentation

6.14.3.1 div()

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

divide point

Parameters

<i>d</i>	scalar to divide position of the point
----------	--

Definition at line 42 of file point.cpp.

```
43 {
44     x = x / d;
45     y = y / d;
46 }
```

6.14.3.2 getNormalPoint()

```
void point::getNormalPoint (
    point predicted,
```



```

    point start,
    point end )

```

provides normal point on a vector of a point

Parameters

<i>predicted</i>	point that caller require normal on the vector
<i>start</i>	point of the vector
<i>end</i>	point of the vector

Definition at line 71 of file point.cpp.

```

72 {
73     pvector a = predicted - start;
74     pvector b = end - start;
75     b.normalize();
76     float a_dot_b = a.dotProduct(b);
77     b.mul(a_dot_b);
78     point normalPoint = start + b;
79     this->x = normalPoint.x;
80     this->y = normalPoint.y;
81 }

```

6.14.3.3 mul()

```

void point::mul (
    float d )

```

multiply point

Parameters

<i>d</i>	scalar to multiply position of the point
----------	--

Definition at line 48 of file point.cpp.

```

49 {
50     x = x * d;
51     y = y * d;
52 }

```

6.14.3.4 operator+() [1/2]

```

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

```

overloaded + operator

Parameters

<i>obj</i>	point to add
------------	--------------

Returns

sum

Definition at line 55 of file point.cpp.

```
56 {  
57     point res;  
58     res.x = x + obj.x;  
59     res.y = y + obj.y;  
60     return res;  
61 }
```

6.14.3.5 operator+() [2/2]

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

overloaded + operator

Parameters

<i>obj</i>	vector to add
------------	---------------

Returns

sum

Definition at line 27 of file point.cpp.

```
28 {  
29     point res;  
30     res.x = x + obj.x;  
31     res.y = y + obj.y;  
32     return res;  
33 }
```

6.14.3.6 operator-()

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

overloaded - operator

Parameters

<i>obj</i>	point to subtract
------------	-------------------

Returns

difference

Definition at line 63 of file point.cpp.

```

64 {
65     pvector res;
66     res.x = x - obj.x;
67     res.y = y - obj.y;
68     return res;
69 }

```

6.14.3.7 operator==()

```

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

```

overloaded == operator

Parameters

<i>obj</i>	point to compare
------------	------------------

Returns

comparison result

Definition at line 35 of file point.cpp.

```

36 {
37     if(x == obj.x && y == obj.y)
38         return true;
39     return false;
40 }

```

6.14.3.8 print()

```

void point::print (
    const string & s )

```

debug function

Parameters

<i>s</i>	explanation string of the log
----------	-------------------------------

Definition at line 83 of file point.cpp.

```

84 {
85     cout << " " << s << " " << x << " " << y << endl;
86 }

```

6.14.4 Member Data Documentation

6.14.4.1 x

```
float point::x
```

x position

Definition at line 88 of file point.h.

6.14.4.2 y

```
float point::y
```

y position

Definition at line 93 of file point.h.

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

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

6.15 prison Class Reference

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

Public Member Functions

- [prison](#) ()
default constructor.

Static Public Member Functions

- static void [loop](#) ()
prisoning scenario loop function

Additional Inherited Members

6.15.1 Detailed Description

Definition at line 15 of file prison.h.

6.15.2 Constructor & Destructor Documentation

6.15.2.1 prison()

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

default constructor.

Definition at line 31 of file prison.cpp.

```
32 {
33     int agentCount = 30;
34     float maxForce = 0.6;
35     float maxSpeed = 0.6;
36
37     name = "stay in prison";
38     createAgent(RANDOM, &agentCount, &maxForce, &maxSpeed);
39     callback = reinterpret_cast <void(*)()> ( (void *)(&loop) );
40 }
```

6.15.3 Member Function Documentation

6.15.3.1 loop()

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

prisoning scenario loop function

prison loop function

Note

opengl callback forces that function to be static

Definition at line 18 of file prison.cpp.

```
19 {
20     for(auto it = agents.begin(); it < agents.end(); it++){
21         view.drawLine(point(-WALL, WALL), point(WALL, WALL), BLUE);
22         view.drawLine(point(WALL, WALL), point(WALL, -WALL), BLUE);
23         view.drawLine(point(WALL, -WALL), point(-WALL, -WALL), BLUE);
24         view.drawLine(point(-WALL, WALL), point(-WALL, -WALL), BLUE);
25         (*it).force = behavior.stayInArea(*it, WALL - DISTANCE);
26         (*it).force += behavior.separation(agents, *it);
27     }
28     refresh();
29 }
```

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

- include/prison.h
- src/prison.cpp

6.16 pursuit Class Reference

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

Public Member Functions

- [pursuit\(\)](#)

default constructor.

Static Public Member Functions

- static void [loop\(\)](#)

pursuing scenario loop function

Additional Inherited Members

6.16.1 Detailed Description

Definition at line 14 of file pursuit.h.

6.16.2 Constructor & Destructor Documentation

6.16.2.1 pursuit()

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

default constructor.

Definition at line 31 of file pursuit.cpp.

```
32 {  
33     name = "pursuit";  
34     createAgent(STATIC, nullptr, nullptr, nullptr);  
35     callback = reinterpret_cast <void(*)()> ( (void *)(&loop) );  
36 }
```

6.16.3 Member Function Documentation

6.16.3.1 loop()

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

pursuing scenario loop function

Note

opengl callback forces that function to be static

Definition at line 15 of file pursuit.cpp.

```
16 {
17     for(auto it = agents.begin(); it < agents.end(); it++){
18         if((*it).getName() == "gazelle"){
19             (*it).targetPoint = view.getMousePosition();
20             (*it).force = behavior.seek(*it);
21         }
22         else{//lion
23             (*it).force = behavior.pursuit(agents, *it, view, "gazelle");
24         }
25         (*it).arrive = true;
26     }
27     refresh();
28 }
29 }
```

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

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

6.17 pvector Class Reference

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

Public Member Functions

- [pvector \(\)](#)
default constructor
- [pvector \(float x, float y\)](#)
constructor
- float [magnitude \(\)](#)
calculates magnitude of the vector
- [pvector & normalize \(\)](#)
normalize
- void [div \(float i\)](#)
vector division
- void [mul \(float i\)](#)
vector multiplication
- void [add \(pvector p\)](#)
addition of vectors
- void [limit \(float limit\)](#)
vector limitation
- float [getAngle \(\)](#)

- calculates vector angle*
- float `dotProduct` (`pvector` v)
dot product of two vectors
- float `angleBetween` (`pvector` v)
angle calculation between two vectors
- void `print` (const string &s)
debug function
- `pvector operator+=` (`pvector` const &obj)
overloaded += operator
- `pvector operator+` (`pvector` const &obj)
overloaded + operator
- `pvector operator-` (`pvector` const &obj)
overloaded - operator
- `pvector operator-` (`point` const &obj)
overloaded - operator
- `pvector operator+` (`point` const &obj)
overloaded + operator
- bool `operator==` (`pvector` const &obj)
overloaded == operator

Public Attributes

- float `x`
x magnitude of the vector
- float `y`
y magnitude of the vector

6.17.1 Detailed Description

Definition at line 17 of file `pvector.h`.

6.17.2 Constructor & Destructor Documentation

6.17.2.1 `pvector()` [1/2]

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

default constructor

See also

`pvector(float x, float y)`

Definition at line 35 of file `pvector.cpp`.

```
36 {
37     x = 0;
38     y = 0;
39 }
```


6.17.2.2 pvector() [2/2]

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

constructor

Parameters

<i>x</i>	magnitude of the vector
<i>y</i>	magnitude of the vector

See also

[pvector\(\)](#)

Definition at line 41 of file pvector.cpp.

```
42 {
43     this->x = x;
44     this->y = y;
45 }
```

6.17.3 Member Function Documentation

6.17.3.1 add()

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

addition of vectors

Parameters

<i>p</i>	vector to add
----------	---------------

Definition at line 59 of file pvector.cpp.

```
60 {
61     x = x + p.x;
62     y = y + p.y;
63 }
```

6.17.3.2 angleBetween()

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

angle calculation between two vectors

Parameters

<i>v</i>	vector to calculate angle
----------	---------------------------

Returns

angle

Definition at line 23 of file pvector.cpp.

```
24 {  
25     float angle = this->dotProduct(v) / (this->magnitude() * v.magnitude());  
26     angle = acos(angle) * 180 / PI;  
27     return angle;  
28 }
```

6.17.3.3 div()

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

vector division

Parameters

<i>i</i>	scalar value to divide
----------	------------------------

Definition at line 47 of file pvector.cpp.

```
48 {  
49     x = x / i;  
50     y = y / i;  
51 }
```

6.17.3.4 dotProduct()

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

dot product of two vectors

Parameters

<i>v</i>	vector to calculate dot product
----------	---------------------------------

Returns

returns scalar dot product

Definition at line 30 of file pvector.cpp.

```

31 {
32     return ((x * v.x) + (y * v.y));
33 }

```

6.17.3.5 getAngle()

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

calculates vector angle

Returns

angle

Definition at line 16 of file pvector.cpp.

```

17 {
18     float angle;
19     angle = atan2 (this->y, this->x) * 180 / PI;
20     return angle;
21 }

```

6.17.3.6 limit()

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

vector limitation

Parameters

<i>limit</i>	value to restrict vector magnitude
--------------	------------------------------------

Definition at line 84 of file pvector.cpp.

```

85 {
86     this->normalize();
87     this->mul(limit);
88 }

```

6.17.3.7 magnitude()

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

calculates magnitude of the vector

Returns

magnitude of the vector

Definition at line 65 of file pvector.cpp.

```

66 {
67     return sqrt((this->x * this->x) + (this->y * this->y));
68 }

```

6.17.3.8 mul()

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

vector multiplication

Parameters

<i>i</i>	scalar value to multiply
----------	--------------------------

Definition at line 53 of file pvector.cpp.

```
54 {
55     x = x * i;
56     y = y * i;
57 }
```

6.17.3.9 normalize()

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

normalize

Returns

normalized vector

Definition at line 70 of file pvector.cpp.

```
71 {
72     float magnitude = this->magnitude();
73     if(magnitude != 0){
74         this->x = this->x / magnitude;
75         this->y = this->y / magnitude;
76     }
77     else{
78         this->x = 0;
79         this->y = 0;
80     }
81     return *this;
82 }
```

6.17.3.10 operator+() [1/2]

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

overloaded + operator

Parameters

<i>obj</i>	point to add
------------	--------------

Returns

sum

Definition at line 112 of file pvector.cpp.

```
113 {  
114     pvector res;  
115     res.x = x + obj.x;  
116     res.y = y + obj.y;  
117     return res;  
118 }
```

6.17.3.11 operator+() [2/2]

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

overloaded + operator

Parameters

<i>obj</i>	vector to add
------------	---------------

Returns

sum

Definition at line 90 of file pvector.cpp.

```
91 {  
92     pvector res;  
93     res.x = x + obj.x;  
94     res.y = y + obj.y;  
95     return res;  
96 }
```

6.17.3.12 operator+=()

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

overloaded += operator

Parameters

<i>obj</i>	vector to add
------------	---------------

Returns

sum

Definition at line 98 of file pvector.cpp.

```

99 {
100     x = x + obj.x;
101     y = y + obj.y;
102     return *this;
103 }

```

6.17.3.13 operator-() [1/2]

```

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

```

overloaded - operator

Parameters

<i>obj</i>	point to subtract
------------	-------------------

Returns

difference

Definition at line 120 of file pvector.cpp.

```

121 {
122     pvector res;
123     res.x = x - obj.x;
124     res.y = y - obj.y;
125     return res;
126 }

```

6.17.3.14 operator-() [2/2]

```

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

```

overloaded - operator

Parameters

<i>obj</i>	vector to subtract
------------	--------------------

Returns

difference

Definition at line 133 of file pvector.cpp.

```

134 {
135     pvector res;
136     res.x = x - obj.x;
137     res.y = y - obj.y;
138     return res;
139 }

```

6.17.3.15 operator==()

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

overloaded == operator

Parameters

<i>obj</i>	vector to check if equal
------------	--------------------------

Returns

comparison result

Definition at line 105 of file pvector.cpp.

```
106 {
107     if (x == obj.x && y == obj.y)
108         return true;
109     return false;
110 }
```

6.17.3.16 print()

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

debug function

Parameters

<i>s</i>	identification text
----------	---------------------

Definition at line 128 of file pvector.cpp.

```
129 {
130     cout << s << " " << x << " " << y << endl;
131 }
```

6.17.4 Member Data Documentation

6.17.4.1 x

```
float pvector::x
```

x magnitude of the vector

Definition at line 140 of file pvector.h.

6.17.4.2 y

```
float pvector::y
```

y magnitude of the vector

Definition at line 145 of file pvector.h.

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

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

6.18 random Class Reference

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

Static Public Member Functions

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

6.18.1 Detailed Description

Definition at line 9 of file random.h.

6.18.2 Member Function Documentation

6.18.2.1 createRandomArray()

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

random array generation

Parameters

<i>arr</i>	struct that includes random values
<i>size</i>	of the array

Definition at line 14 of file random.cpp.


```

14                                     {
15     srand(time(NULL));
16     for(int i=0; i<size; i++)
17         arr[i] = i+1;
18
19     for (int i=0; i < size; i++){
20         int r = rand() % size;
21         swap(arr[i], arr[r]);
22     }
23 }

```

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

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

6.19 scenario Class Reference

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

Public Member Functions

- [scenario](#) ()
default constructor.
- void [createAgent](#) (int type, int *count, float *force, float *speed)
agent creation
- void [initGL](#) (int *argv, char **argc)
graphics initialization

Static Public Member Functions

- static void [refresh](#) ()
refreshes all items

Public Attributes

- void(* [callback](#))()
openGL screen refresh callback function, used as main loop in derived classes

Static Public Attributes

- static vector< [agent](#) > [agents](#)
structure stores agents
- static [graphics view](#)
graphics instance used
- static [steeringBehavior](#) [behavior](#)
behavior instance used
- static string [name](#)
scenario name

6.19.1 Detailed Description

Definition at line 19 of file scenario.h.

6.19.2 Constructor & Destructor Documentation

6.19.2.1 scenario()

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

default constructor.

Definition at line 27 of file scenario.cpp.

```
28 {
29     view = graphics();
30 }
```

6.19.3 Member Function Documentation

6.19.3.1 createAgent()

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

agent creation

Parameters

<i>type</i>	type of creation method
<i>count</i>	number of agents to be created
<i>force</i>	max force of agents to be created
<i>speed</i>	max speed of agents to be created

Definition at line 107 of file scenario.cpp.

```
108 {
109     if(type == TROOP){
110         createTroop(*count);
111     }
112     else if(type == RANDOM){
113         createRandomAgents(*count, *force, *speed);
114     }
115     else if(type == STATIC){
116         createStaticAgents();
117     }
118     else{
```

```

119         //error message
120     }
121 }

```

6.19.3.2 initGL()

```

void scenario::initGL (
    int * argv,
    char ** argc )

```

graphics initialization

Parameters

<i>argv</i>	list of user arguments
<i>argc</i>	number of user arguments

Definition at line 22 of file scenario.cpp.

```

23 {
24     view.initGraphics(argc, argv, callback);
25 }

```

6.19.3.3 refresh()

```

void scenario::refresh ( ) [static]

```

refreshes all items

Note

opengl callback forces that function to be static

Definition at line 32 of file scenario.cpp.

```

33 {
34     point textPosition = point(-34, 32.25);
35
36     for(auto it = agents.begin(); it < agents.end(); it++){
37         (*it).draw(view);
38     }
39
40     view.drawText(name, textPosition);
41     view.refreshScene();
42 }

```

6.19.4 Member Data Documentation

6.19.4.1 agents

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

structure stores agents

Note

opengl callback forces that function to be static

Definition at line 52 of file scenario.h.

6.19.4.2 behavior

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

behavior instance used

Note

opengl callback forces that function to be static

Definition at line 64 of file scenario.h.

6.19.4.3 callback

```
void(* scenario::callback) ()
```

OpenGL screen refresh callback function, used as main loop in derived classes

Definition at line 75 of file scenario.h.

6.19.4.4 name

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

scenario name

Note

opengl callback forces that function to be static

Definition at line 70 of file scenario.h.

6.19.4.5 view

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

graphics instance used

Note

opengl callback forces that function to be static

Definition at line 58 of file scenario.h.

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

- include/scenario.h
- src/scenario.cpp

6.20 steeringBehavior Class Reference

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

Public Member Functions

- [pvector stayInArea](#) ([agent](#) &[agent](#), int turnPoint)
gets reflection force
- [pvector inFlowField](#) ([agent](#) &[agent](#), [flowField](#) &flow)
gets flow field force
- [pvector stayInPath](#) ([agent](#) &[agent](#), [path](#) &[path](#), [graphics](#) view)
gets force to follow path
- [pvector seek](#) ([agent](#) &[agent](#))
force to seek
- [pvector separation](#) (vector< [agent](#) > agents, [agent](#) &[agent](#))
force to separate
- [pvector cohesion](#) (vector< [agent](#) > boids, [agent](#) &[agent](#))
force to cohesion
- [pvector align](#) (vector< [agent](#) > boids, [agent](#) &[agent](#))
force to align
- [pvector wander](#) ([agent](#) &[agent](#))
force to wander
- [pvector pursuit](#) (vector< [agent](#) > boids, [agent](#) &pursuer, [graphics](#) view, string name)
force to pursue
- [pvector evade](#) (vector< [agent](#) > boids, [agent](#) &evader, [graphics](#) view, string name)
force to evade
- [pvector flee](#) ([agent](#) &[agent](#), [graphics](#) &view, [point](#) p)
force to flee
- [pvector avoid](#) (vector< [obstacle](#) > obstacles, [agent](#) &[agent](#))
force to avoid
- void [setAngle](#) ([pvector](#) &p, float angle)
applies angle on vector

6.20.1 Detailed Description

Definition at line 35 of file steeringBehavior.h.

6.20.2 Member Function Documentation

6.20.2.1 align()

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

force to align

Parameters

<i>agent</i>	to be aligned
<i>boids</i>	list of all the agents

Returns

force to be applied

Definition at line 119 of file steeringBehavior.cpp.

```
120 {
121     float neighborDist = 30;
122     pvector sum {0,0};
123     int count = 0;
124     for(auto it = boids.begin(); it < boids.end(); it++){
125         float d = (agent.position - (*it).position).magnitude();
126         if( (d > 0) && (d < neighborDist) ){
127             sum += (*it).velocity;
128             count++;
129         }
130     }
131     if(count > 0){
132         sum.div(count);
133         sum.normalize().mul(agent.maxSpeed);
134         agent.steering = sum - agent.velocity;
135         return agent.steering;
136     }
137     return pvector(0,0);
138 }
```

6.20.2.2 avoid()

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

force to avoid

Parameters

<i>agent</i>	agent that will avoid from obstacles
<i>obstacles</i>	list of all existing objects

Returns

force to be applied

Definition at line 183 of file steeringBehavior.cpp.

```

184 {
185     float dynamic_length = agent.velocity.magnitude() / agent.maxSpeed;
186     pvector vel = agent.velocity;
187     vel.normalize().mul(dynamic_length);
188     pvector ahead = vel + agent.position;
189     vel.mul(6);
190     pvector ahead2 = vel + agent.position;
191     //view.drawPoint(point(ahead.x, ahead.y));
192     //view.drawPoint(point(ahead2.x, ahead2.y));
193
194     for(auto it = obstacles.begin(); it < obstacles.end(); it++){
195         float dist = (ahead - (*it).p).magnitude();
196         float dist2 = (ahead2 - (*it).p).magnitude();
197         if(dist < (*it).r + 2 || dist2 < (*it).r + 2){
198             pvector avoidance = ahead - (*it).p;
199             avoidance.normalize().mul(20);
200             /*a = point(avoidance.x, avoidance.y);
201             view.drawLine(agent.position, agent.position + a, color(0,1,0));*/
202             return avoidance;
203         }
204     }
205     return pvector(0,0);
206 }
```

6.20.2.3 cohesion()

```

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

force to cohesion

Parameters

<i>agent</i>	to go to center of other agents, with specified distance
<i>boids</i>	list of all the agents

Returns

force to be applied

Definition at line 140 of file steeringBehavior.cpp.

```

141 {
142     float neighborDist = 20;
143     point sum {0,0};
144     int count = 0;
145     for(auto it = boids.begin(); it < boids.end(); it++){
146         float d = (agent.position - (*it).position).magnitude();
147         if( (d > 0) && (d < neighborDist) ){
```

```

148         sum = sum + (*it).position;
149         count++;
150     }
151 }
152 if(count>0){
153     sum.div(count);
154     agent.targetPoint = sum;
155     return seek(agent);
156 }
157 return pvector(0,0);
158 }

```

6.20.2.4 evade()

```

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

```

force to evade

Parameters

<i>evader</i>	agent that will escape
<i>view</i>	used for debugging
<i>boids</i>	list of all the agents
<i>name</i>	other agent to evade

Returns

force to be applied

Definition at line 47 of file steeringBehavior.cpp.

```

48 {
49     agent target;
50     for(auto it = boids.begin(); it < boids.end(); it++){
51         if((*it).getName() == name){
52             target = *it;
53         }
54     }
55
56     point p = point(evader.position.x + 2, evader.position.y - 2);
57     view.drawText(evader.getName(), p);
58     p = point(target.position.x + 2, target.position.y - 2);
59     view.drawText(target.getName(), p);
60
61     pvector targetVel = target.velocity;
62     targetVel.mul(5); //TODO: magic number
63
64     point futurePos = target.position + targetVel;
65     view.drawPoint(futurePos);
66
67     pvector dist = evader.position - futurePos;
68     dist.normalize().mul( 1 / dist.magnitude() );
69
70     evader.targetPoint = evader.position + dist;
71     return flee(evader, view, futurePos);
72 }

```


6.20.2.5 flee()

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

force to flee

Parameters

<i>agent</i>	agent that will flee
<i>view</i>	used for debugging
<i>p</i>	point that agent flees

Returns

force to be applied

Definition at line 28 of file steeringBehavior.cpp.

```
29 {
30     int radius = 15;
31
32     pvector dist = agent.targetPoint - p;
33     view.drawPoint(agent.targetPoint);
34
35     if(dist.magnitude() < radius){
36         agent.arrive = false;
37         agent.desiredVelocity = agent.position - p;
38     }
39     else{
40         agent.arrive = true;
41         agent.desiredVelocity = agent.targetPoint - agent.position;
42     }
43     agent.steering = agent.desiredVelocity - agent.velocity;
44     return agent.steering;
45 }
```

6.20.2.6 inFlowField()

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

gets flow field force

Parameters

<i>agent</i>	unit to apply flow field
<i>flow</i>	field

Returns

force to be applied

Definition at line 238 of file steeringBehavior.cpp.

```

239 {
240     //pos_x, pos_y must be non negative integer
241     int pos_x = abs((int)agent.position.x) % WIDTH;
242     int pos_y = abs((int)agent.position.y) % HEIGHT;
243     //TODO: modification required for non uniform fields
244     return flow.getField(pos_x, pos_y);
245 }

```

6.20.2.7 pursuit()

```

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

```

force to pursue

Parameters

<i>pursuer</i>	agent that will follow specified agent
<i>view</i>	used for debugging
<i>boids</i>	list of all the agents
<i>name</i>	other agent to pursue

Returns

force to be applied

Definition at line 74 of file steeringBehavior.cpp.

```

75 {
76     agent target;
77     for(auto it = boids.begin(); it < boids.end(); it++){
78         if((*it).getName() == name){
79             target = *it;
80         }
81     }
82
83     point p = point(target.position.x + 2, target.position.y - 2);
84     view.drawText(target.getName(), p);
85     p = point(pursuer.position.x + 2, pursuer.position.y - 2);
86     view.drawText(pursuer.getName(), p);
87
88     float dist = (target.position - pursuer.position).magnitude();
89     float t = dist / target.maxSpeed;
90
91     pvector targetVel = target.velocity;
92     targetVel.mul(t);
93     point futurePos = target.position + targetVel;
94     pursuer.targetPoint = futurePos;
95     return seek(pursuer);
96 }

```

6.20.2.8 seek()

```

pvector steeringBehavior::seek (
    agent & agent )

```

force to seek

Parameters

<i>agent</i>	that will go to specific target point
--------------	---------------------------------------

Returns

force to be applied

Definition at line 208 of file steeringBehavior.cpp.

```

209 {
210     agent.desiredVelocity = agent.targetPoint - agent.position;
211     agent.steering = agent.desiredVelocity - agent.velocity;
212     return agent.steering;
213 }
```

6.20.2.9 separation()

```

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

force to separate

Parameters

<i>agent</i>	agent that will be stayed away
<i>agents</i>	list of all the agents

Returns

force to be applied

Definition at line 160 of file steeringBehavior.cpp.

```

161 {
162     float desiredSeparation = 5;
163     pvector sum = pvector(0,0);
164     int count = 0;
165     for(auto it = agents.begin(); it < agents.end(); it++){
166         float d = (agent.position - (*it).position).magnitude();
167         if( (d > 0) && (d < desiredSeparation) ){
168             pvector diff = agent.position - (*it).position;
169             diff.normalize().div(d);
170             sum = sum + diff;
171             count++;
172         }
173     }
174     if(count > 0){
175         sum.div(count);
176         sum.normalize().mul(agent.maxSpeed);
177         agent.steering = sum - agent.velocity;
178         return agent.steering;
179     }
180     return pvector(0,0);
181 }
```

6.20.2.10 setAngle()

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

applies angle on vector

Parameters

<i>angle</i>	that will be set
<i>p</i>	vector that angle will be applied

Definition at line 22 of file steeringBehavior.cpp.

```
23 {
24     p.x = cos ( angle * PI / 180.0 );
25     p.y = sin ( angle * PI / 180.0 );
26 }
```

6.20.2.11 stayInArea()

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

gets reflection force

Parameters

<i>agent</i>	unit to check
<i>turnpoint</i>	defines border to apply force

Returns

force to be applied

Definition at line 247 of file steeringBehavior.cpp.

```
248 {
249     if(agent.position.x >= turnPoint){
250         agent.desiredVelocity = pvector( -agent.maxSpeed, agent.velocity.y );
251         agent.steering = agent.desiredVelocity - agent.velocity;
252         return agent.steering;
253     }
254     else if(agent.position.x <= -turnPoint){
255         agent.desiredVelocity = pvector( agent.maxSpeed, agent.velocity.y );
256         agent.steering = agent.desiredVelocity - agent.velocity;
257         return agent.steering;
258     }
259     else if(agent.position.y >= turnPoint){
260         agent.desiredVelocity = pvector( agent.velocity.x, -agent.maxSpeed );
261         agent.steering = agent.desiredVelocity - agent.velocity;
262         return agent.steering;
263     }
264     else if(agent.position.y <= -turnPoint){
265         agent.desiredVelocity = pvector( agent.velocity.x, agent.maxSpeed );
266         agent.steering = agent.desiredVelocity - agent.velocity;
267         return agent.steering;
268     }
```

```

269     return pvector(0,0);
270 }

```

6.20.2.12 stayInPath()

```

pvector steeringBehavior::stayInPath (
    agent & agent,
    path & path,
    graphics view )

```

gets force to follow path

Parameters

<i>agent</i>	to follow the pathk
<i>path</i>	to follow
<i>view</i>	used for debugging

Returns

force to be applied

Definition at line 215 of file steeringBehavior.cpp.

```

216 {
217     float worldRecord = 1000000;
218     point normalPoint, predictedPos, start, end;
219     pvector distance;
220     for(auto it = path.points.begin(); it < path.points.end()-1; it++){
221         start = point((*it).x, (*it).y);
222         end = point((*it+1).x, (*it+1).y);
223         predictedPos = agent.position + agent.velocity;
224         normalPoint.getNormalPoint(predictedPos, start, end);
225         if (normalPoint.x < start.x || normalPoint.x > end.x){
226             normalPoint = end;
227         }
228         distance = predictedPos - normalPoint;
229         if (distance.magnitude() < worldRecord){
230             worldRecord = distance.magnitude();
231             agent.targetPoint = end;
232         }
233         view.drawPoint(agent.targetPoint);
234     }
235     return seek(agent);
236 }

```

6.20.2.13 wander()

```

pvector steeringBehavior::wander (
    agent & agent )

```

force to wander

Parameters

<i>agent</i>	agent that will wander
--------------	------------------------

Returns

force to be applied

Definition at line 98 of file steeringBehavior.cpp.

```

99 {
100     pvector circleCenter = agent.velocity;
101     circleCenter.normalize().mul(CIRCLE_DISTANCE + CIRCLE_RADIUS);
102
103     int wanderAngle = (rand() % 360);
104     pvector displacement {0, 1};
105     setAngle(displacement, wanderAngle);
106     displacement.mul(CIRCLE_RADIUS);
107
108     agent.desiredVelocity = displacement + circleCenter;
109     agent.steering = agent.desiredVelocity - agent.velocity;
110
111     //move it to the center when it is out of screen
112     if(agent.position.x > WIDTH || agent.position.x < -WIDTH ||
113        agent.position.y > HEIGHT || agent.position.y < -HEIGHT)
114         agent.position = point(0,0);
115
116     return agent.steering;
117 }
```

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

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

6.21 wander Class Reference

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

Public Member Functions

- [wander \(\)](#)
default constructor

Static Public Member Functions

- static void [loop \(\)](#)
wander scenario loop function

Additional Inherited Members

6.21.1 Detailed Description

Definition at line 14 of file wander.h.

6.21.2 Constructor & Destructor Documentation

6.21.2.1 wander()

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

default constructor

Todo business logic will be changed

Definition at line 24 of file wander.cpp.

```
25 {
26     int agentCount = 30;
27     float maxForce = 0.3;
28     float maxSpeed = 0.6;
29
30     name = "wandering objects";
31     createAgent(RANDOM, &agentCount, &maxForce, &maxSpeed);
32     callback = reinterpret_cast <void(*)()> ( (void *)(&loop) );
33 }
```

6.21.3 Member Function Documentation

6.21.3.1 loop()

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

wander scenario loop function

Note

opengl callback forces that function to be static

Definition at line 15 of file wander.cpp.

```
16 {
17     for(auto it = agents.begin(); it < agents.end(); it++){
18         (*it).force = behavior.wander(*it);
19     }
20
21     refresh();
22 }
```

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

- include/wander.h
- src/wander.cpp

6.22 windy Class Reference

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

Public Member Functions

- [windy\(\)](#)
default constructor.

Static Public Member Functions

- static void [loop\(\)](#)
windy scenario loop function

Static Public Attributes

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

Additional Inherited Members

6.22.1 Detailed Description

Definition at line 15 of file windy.h.

6.22.2 Constructor & Destructor Documentation

6.22.2.1 windy()

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

default constructor.

Definition at line 29 of file windy.cpp.

```
30 {  
31     int agentCount = 30;  
32     float maxForce = 0.3;  
33     float maxSpeed = 0.6;  
34  
35     name = "flow field";  
36     createAgent(RANDOM, &agentCount, &maxForce, &maxSpeed);  
37     callback = reinterpret_cast<void(*)()> ( (void *)(&loop) );  
38 }
```

6.22.3 Member Function Documentation

6.22.3.1 loop()

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

windy scenario loop function

Note

opengl callback forces that function to be static

Definition at line 17 of file windy.cpp.

```
18 {  
19     for(auto it = agents.begin(); it < agents.end(); it++){  
20         flow = flowField(pvector(GRAVITY));  
21         (*it).force = behavior.inFlowField(*it, flow);  
22     }  
23     flow = flowField(pvector(WIND_WEST));  
24     (*it).force += behavior.inFlowField(*it, flow);  
25 }  
26 refresh();  
27 }
```

6.22.4 Member Data Documentation

6.22.4.1 flow

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

flow field used

Note

opengl callback forces that function to be static

Definition at line 32 of file windy.h.

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

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

Chapter 7

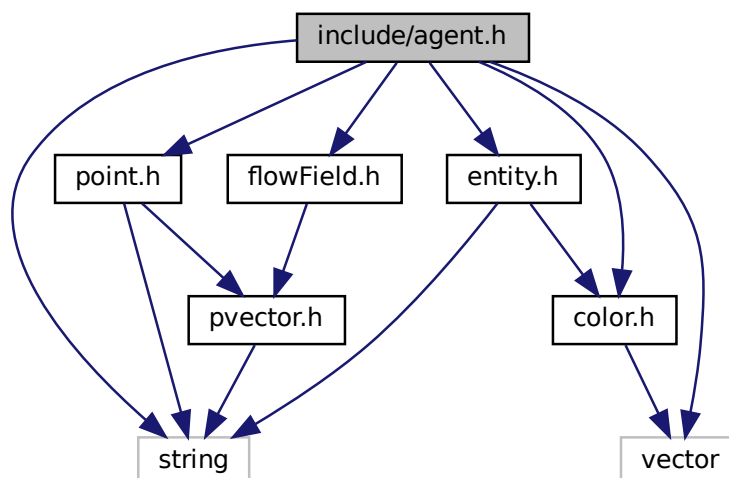
File Documentation

7.1 include/agent.h File Reference

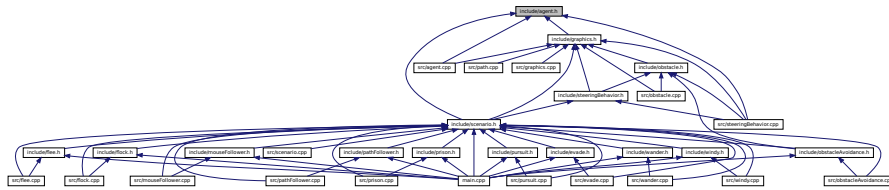
agent class defines all agent specifications

```
#include "point.h"  
#include "color.h"  
#include "entity.h"  
#include "flowField.h"  
#include <vector>  
#include <string>
```

Include dependency graph for agent.h:



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



Classes

- class [agent](#)

7.1.1 Detailed Description

agent class defines all agent specifications

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

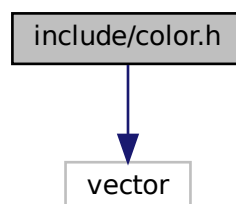
Date

14.05.2021

7.2 include/color.h File Reference

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

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



7.2.2.2 BLUE

```
#define BLUE color(0,0,1)
```

Definition at line 11 of file color.h.

7.2.2.3 CYAN

```
#define CYAN color(0,1,1)
```

Definition at line 13 of file color.h.

7.2.2.4 GREEN

```
#define GREEN color(0,1,0)
```

Definition at line 12 of file color.h.

7.2.2.5 MAGENDA

```
#define MAGENDA color(1,0,1)
```

Definition at line 16 of file color.h.

7.2.2.6 RED

```
#define RED color(1,0,0)
```

Definition at line 14 of file color.h.

7.2.2.7 WHITE

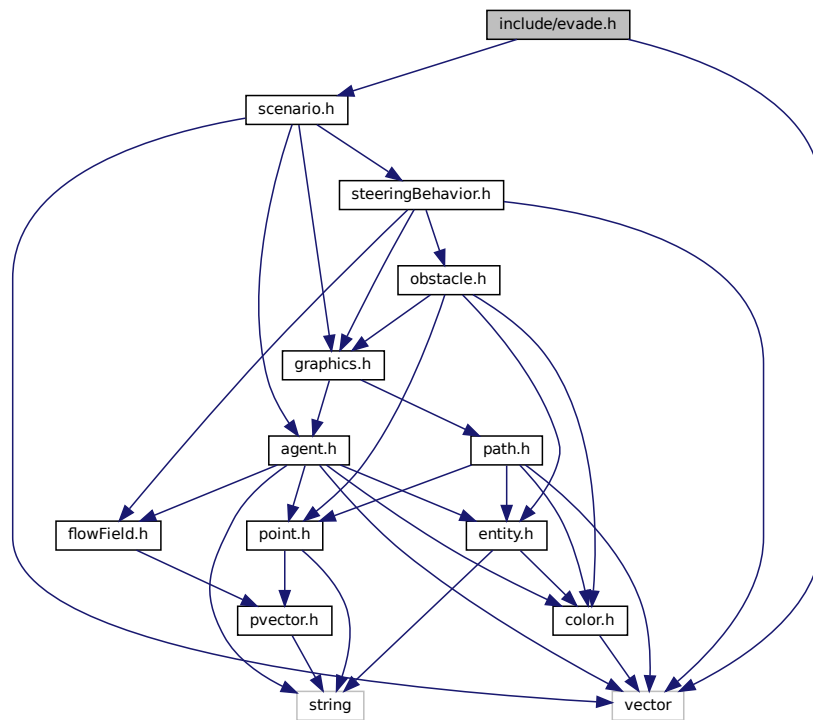
```
#define WHITE color(1,1,1)
```

Definition at line 17 of file color.h.

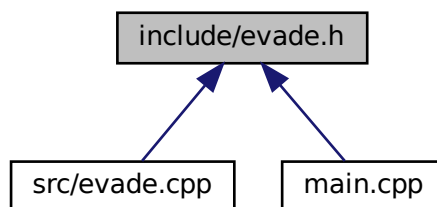
7.4 include/evade.h File Reference

evade class inherited from scenario class

```
#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](#)

7.4.1 Detailed Description

evade class inherited from scenario class

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

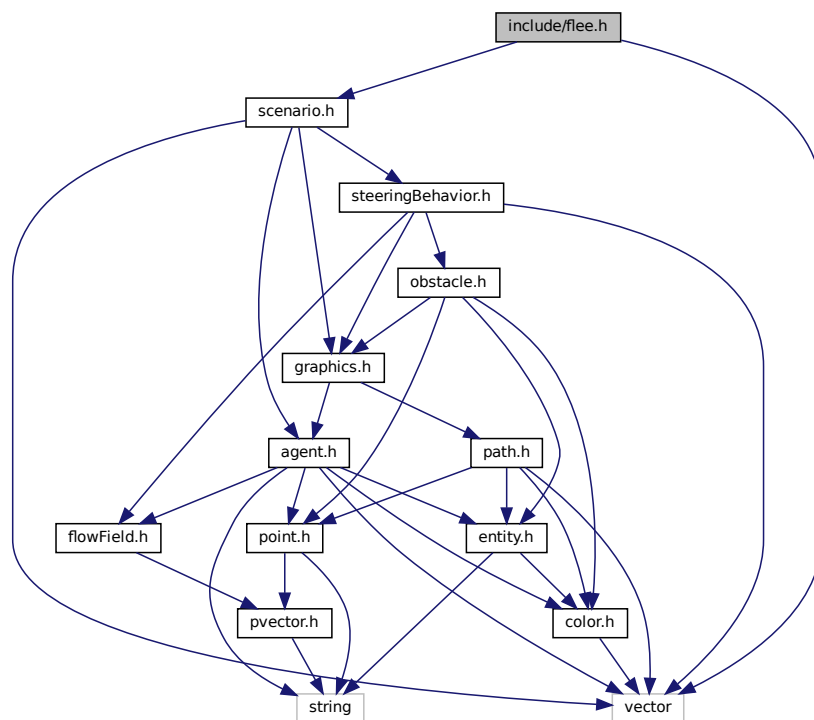
Date

15.05.2021

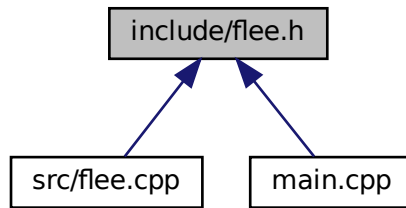
7.5 include/flee.h File Reference

agents flee from mouse scenario

```
#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](#)

7.5.1 Detailed Description

agents flee from mouse scenario

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

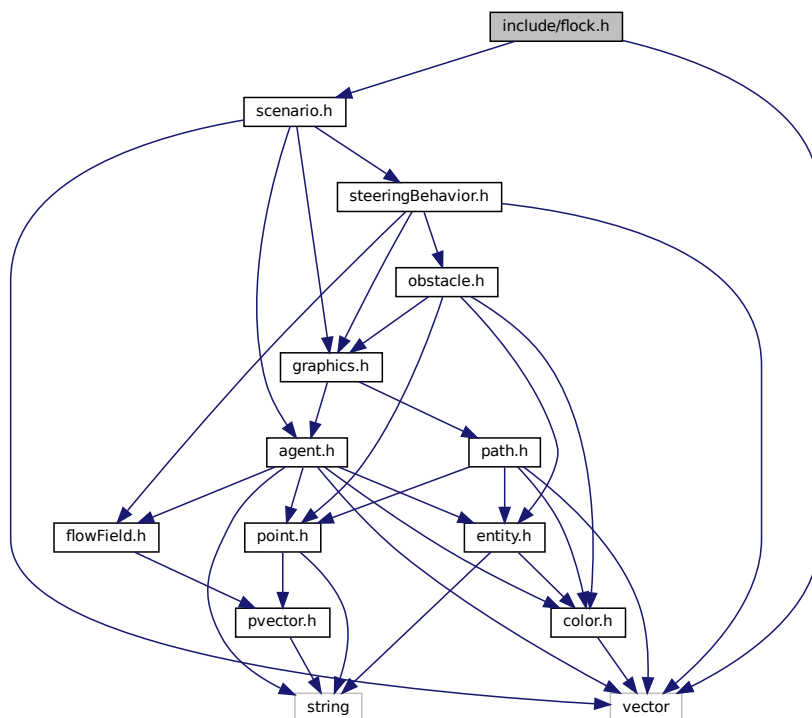
15.05.2021

7.6 include/flock.h File Reference

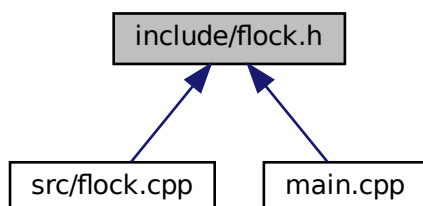
flocking agents scenario

```
#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](#)

7.6.1 Detailed Description

flocking agents scenario

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

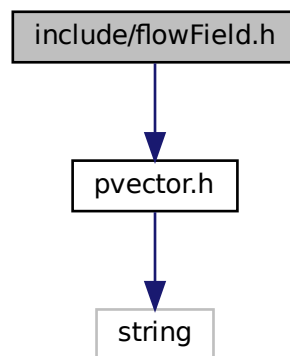
15.05.2021

7.7 include/flowField.h File Reference

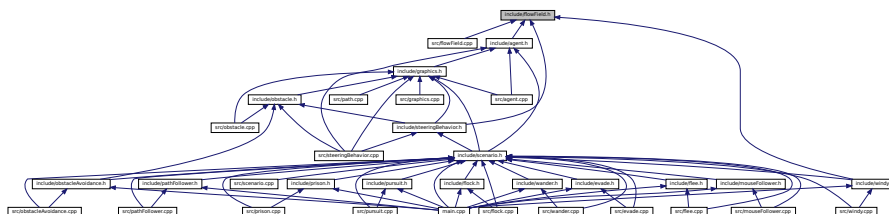
[flowField](#) class, screen can be filled with a force for each pixel

```
#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 FIELD_WIDTH 34`
- `#define FIELD_HEIGHT 34`
- `#define WIND_WEST 0.1, 0.0`
- `#define GRAVITY 0.0, -0.1`

7.7.1 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

7.7.2 Macro Definition Documentation

7.7.2.1 FIELD_HEIGHT

```
#define FIELD_HEIGHT 34
```

Definition at line 13 of file `flowField.h`.

7.7.2.2 FIELD_WIDTH

```
#define FIELD_WIDTH 34
```

Definition at line 12 of file `flowField.h`.

7.7.2.3 GRAVITY

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

Definition at line 16 of file `flowField.h`.

Macros

- `#define WIDTH 34`
- `#define HEIGHT 34`
- `#define ESC 27`
- `#define PI 3.14159265`

7.8.1 Detailed Description

graphics class, drives openGL

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

15.05.2021

7.8.2 Macro Definition Documentation

7.8.2.1 ESC

```
#define ESC 27
```

Definition at line 16 of file graphics.h.

7.8.2.2 HEIGHT

```
#define HEIGHT 34
```

Definition at line 14 of file graphics.h.

7.8.2.3 PI

```
#define PI 3.14159265
```

Definition at line 17 of file graphics.h.

7.8.2.4 WIDTH

```
#define WIDTH 34
```

Definition at line 13 of file graphics.h.

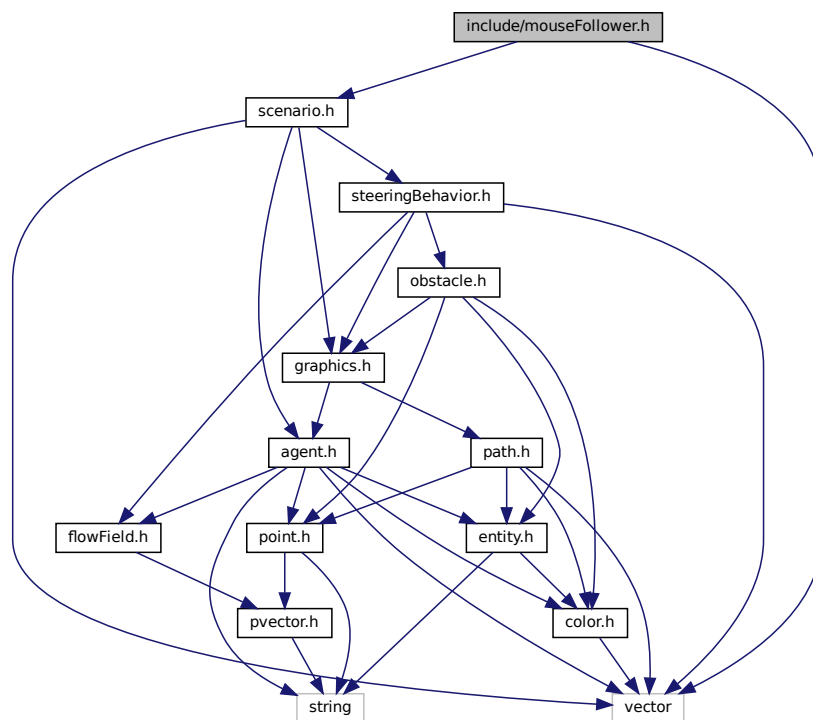
7.9 include/mouseFollower.h File Reference

agents follow mouse scenario

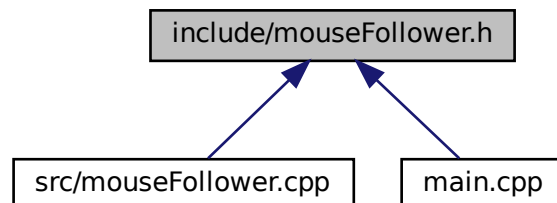
```
#include "scenario.h"
```

```
#include <vector>
```

Include dependency graph for mouseFollower.h:



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



Classes

- class [mouseFollower](#)

7.9.1 Detailed Description

agents follow mouse scenario

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

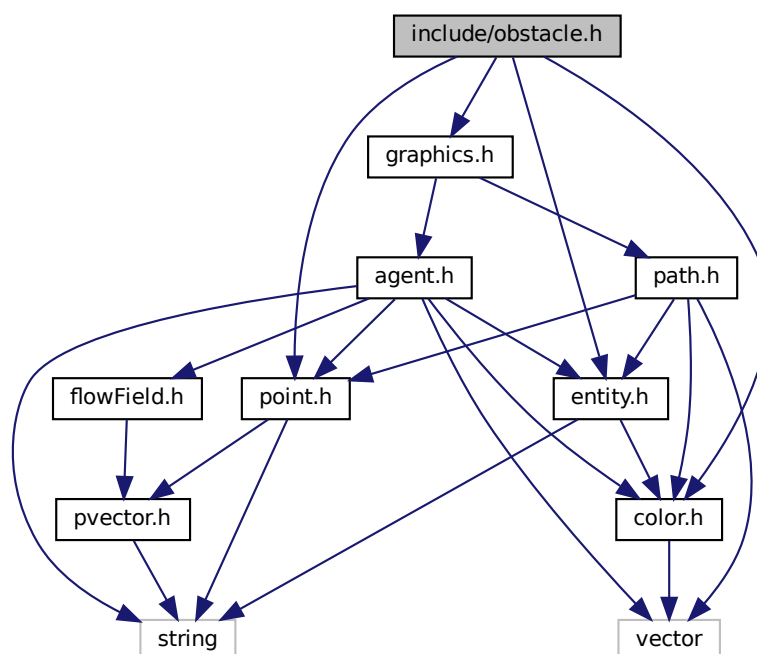
Date

15.05.2021

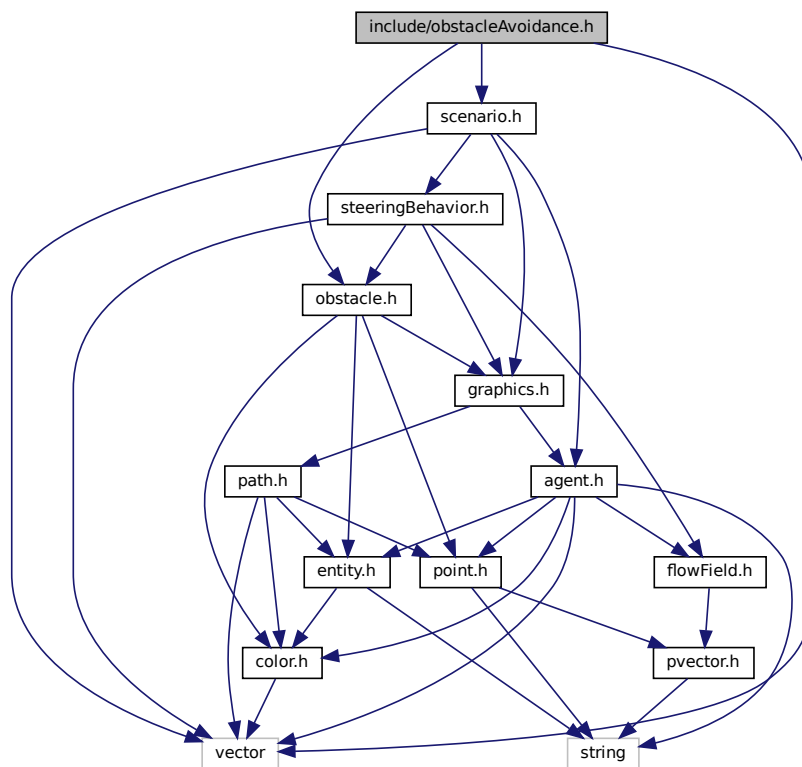
7.10 include/obstacle.h File Reference

circular obstacles for agent avoidance behaviors

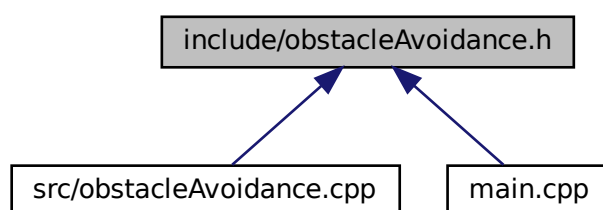
```
#include "point.h"
#include "graphics.h"
#include "color.h"
#include "entity.h"
Include dependency graph for obstacle.h:
```



Include dependency graph for obstacleAvoidance.h:



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



Classes

- class [obstacleAvoidance](#)

7.11.1 Detailed Description

agents avoid from obstacles scenario

Classes

- class [path](#)

7.12.1 Detailed Description

path class used for path following steering behaviors.

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

12.05.2021

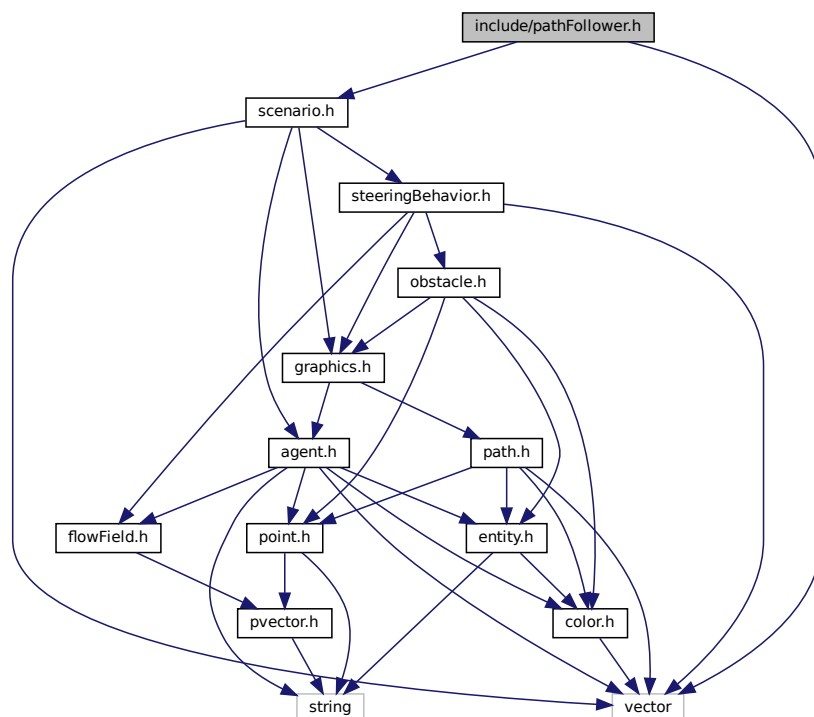
7.13 include/pathFollower.h File Reference

path following scenario

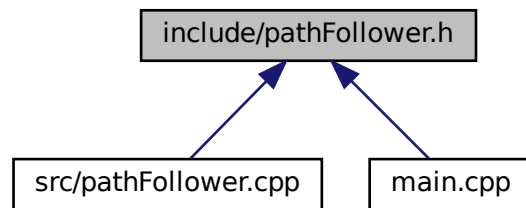
```
#include "scenario.h"
```

```
#include <vector>
```

Include dependency graph for pathFollower.h:



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



Classes

- class [pathFollower](#)

7.13.1 Detailed Description

path following scenario

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

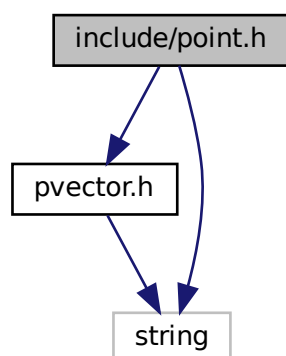
15.05.2021

7.14 include/point.h File Reference

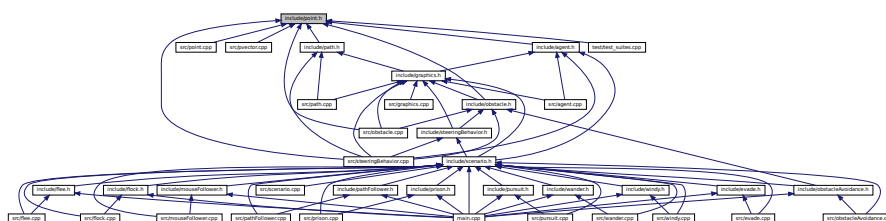
point class used for point operations

```
#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](#)

7.14.1 Detailed Description

point class used for point operations

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

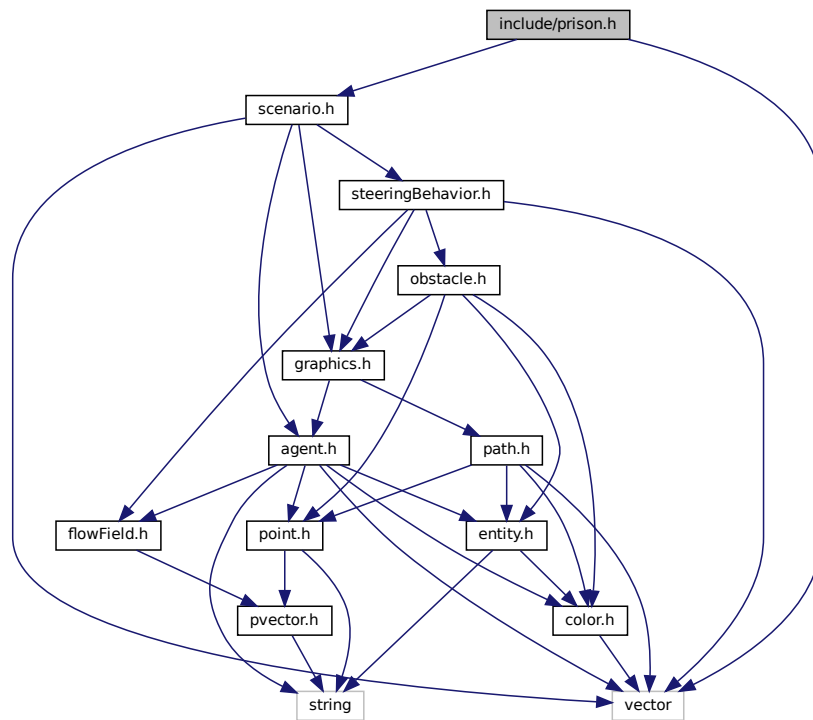
Date

15.05.2021

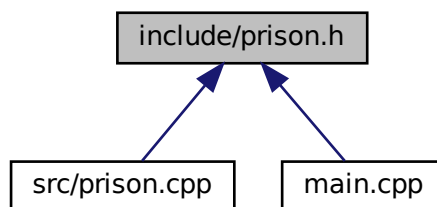
7.15 include/prison.h File Reference

agents cant escape from field scenario

```
#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](#)

7.15.1 Detailed Description

agents cant escape from field scenario

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

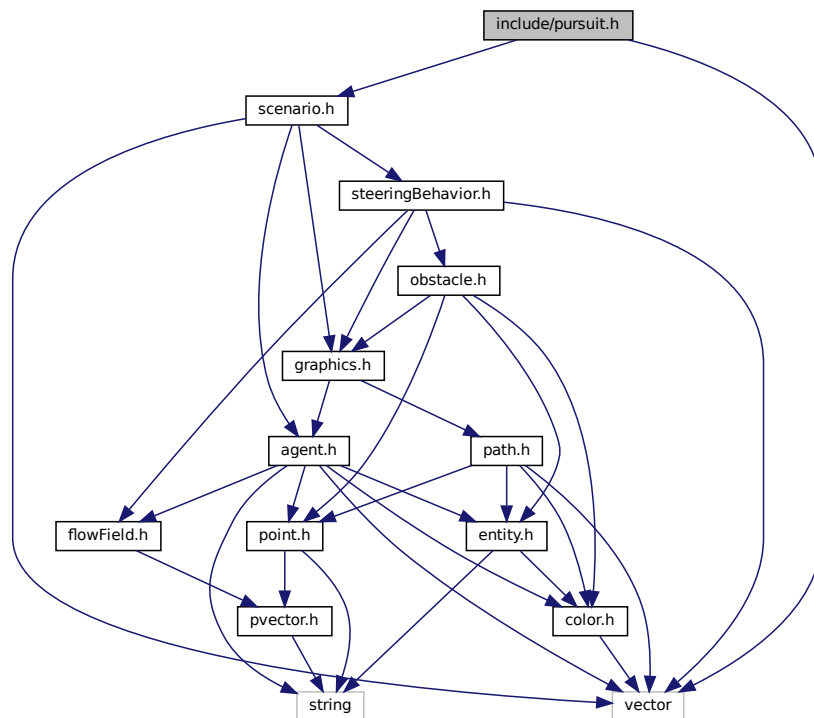
Date

15.05.2021

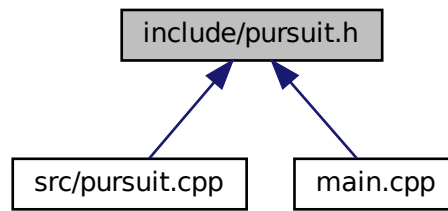
7.16 include/pursuit.h File Reference

one agent pursue other one scenario

```
#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](#)

7.16.1 Detailed Description

one agent pursue other one scenario

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

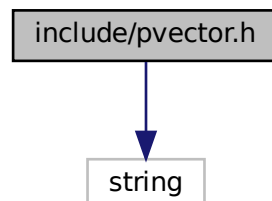
15.05.2021

7.17 include/pvector.h File Reference

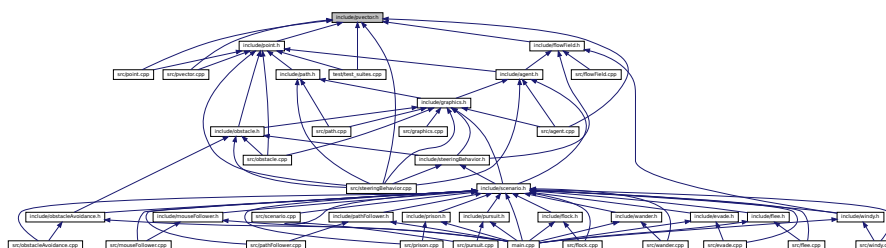
pvector class used for 2D vector operations

```
#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

7.17.1 Detailed Description

pvector class used for 2D vector operations

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

15.05.2021

7.17.2 Macro Definition Documentation

7.17.2.1 PI

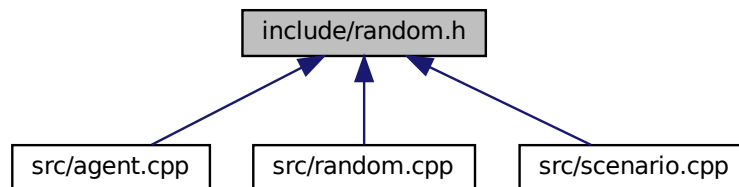
```
#define PI 3.14159265
```

Definition at line 11 of file pvector.h.

7.18 include/random.h File Reference

utility class for random operations

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



Classes

- class [random](#)

7.18.1 Detailed Description

utility class for random operations

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

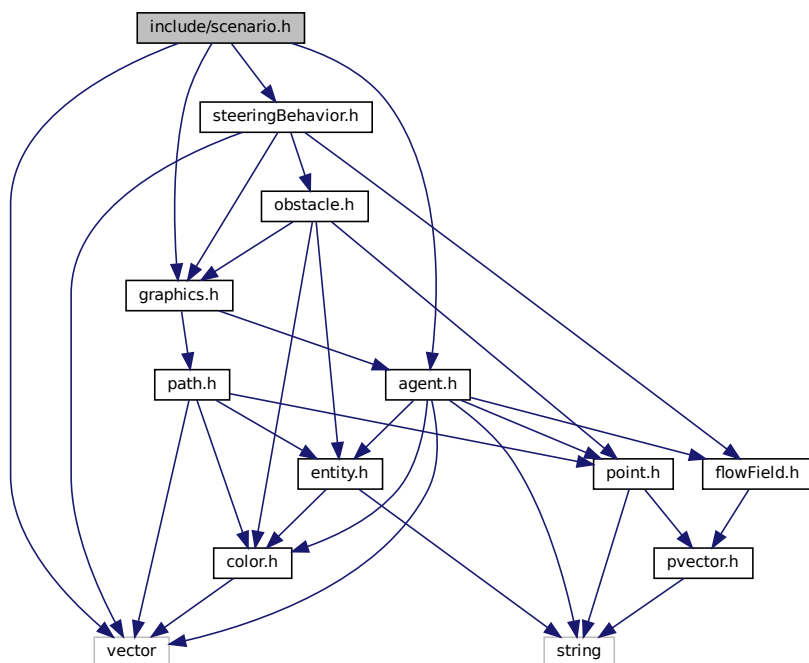
15.05.2021

7.19 include/scenario.h File Reference

base class for all scenarios

```
#include "agent.h"  
#include "graphics.h"  
#include "steeringBehavior.h"
```

Include dependency graph for scenario.h:



- class **scenario**

- enum types { RANDOM =0, STATIC, TROOP }

15.05.2021

7.19.2 Enumeration Type Documentation

7.19.2.1 types

enum `types`

Enumerator

RANDOM	
STATIC	
TROOP	

Definition at line 17 of file scenario.h.

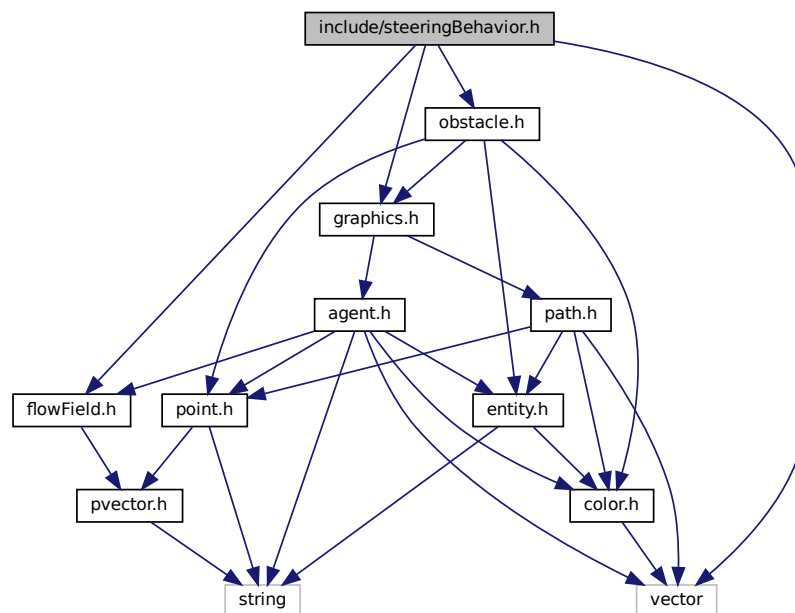
```
17 { RANDOM=0, STATIC, TROOP };
```

7.20 include/steeringBehavior.h File Reference

functions for autonomous steering behaviors

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

Include dependency graph for steeringBehavior.h:



- class `steeringBehavior`

- #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

functions for autonomous steering behaviors

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

15.05.2021

7.20.2.1 AVOID OBSTACLE

Definition at line 21 of file steeringBehavior.h.

7.20.2.2 CIRCLE_DISTANCE

```
#define CIRCLE_DISTANCE 0.1
```

Definition at line 15 of file steeringBehavior.h.

7.20.2.3 CIRCLE_RADIUS

```
#define CIRCLE_RADIUS 0.4
```

Definition at line 16 of file steeringBehavior.h.

7.20.2.4 EVADE

```
#define EVADE 10
```

Definition at line 27 of file steeringBehavior.h.

7.20.2.5 FLEE

```
#define FLEE 8
```

Definition at line 25 of file steeringBehavior.h.

7.20.2.6 FLOCK

```
#define FLOCK 6
```

Definition at line 23 of file steeringBehavior.h.

7.20.2.7 FOLLOW_MOUSE

```
#define FOLLOW_MOUSE 1
```

Definition at line 18 of file steeringBehavior.h.

7.20.2.8 IN_FLOW_FIELD

```
#define IN_FLOW_FIELD 3
```

Definition at line 20 of file steeringBehavior.h.

7.20.2.9 PURSUIT

```
#define PURSUIT 9
```

Definition at line 26 of file steeringBehavior.h.

7.20.2.10 STAY_IN_FIELD

```
#define STAY_IN_FIELD 2
```

Definition at line 19 of file steeringBehavior.h.

7.20.2.11 STAY_IN_PATH

```
#define STAY_IN_PATH 5
```

Definition at line 22 of file steeringBehavior.h.

7.20.2.12 WANDER

```
#define WANDER 7
```

Definition at line 24 of file steeringBehavior.h.

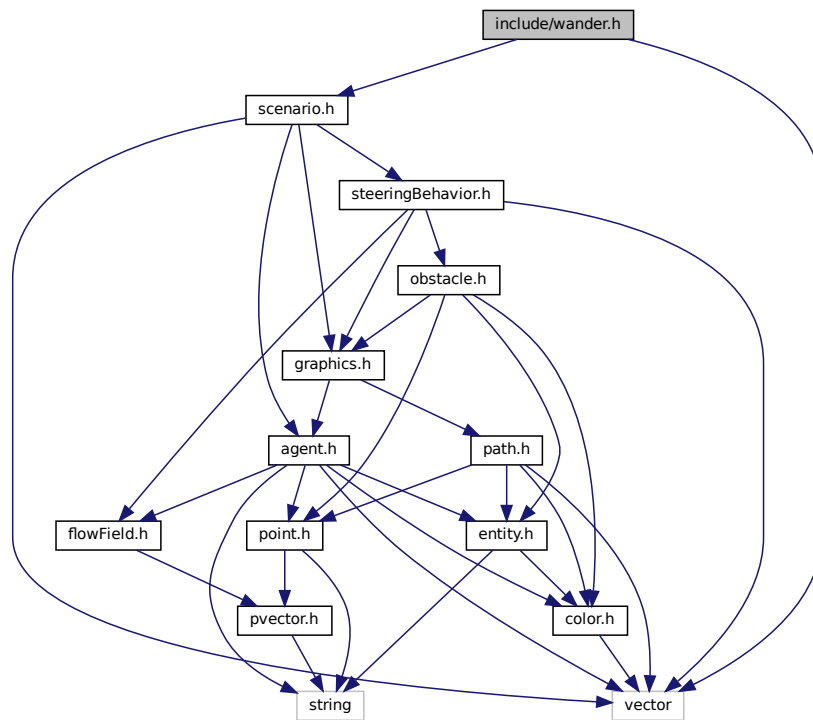
7.21 include/wander.h File Reference

random wandering agents scenario

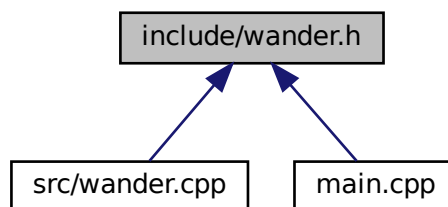
```
#include "scenario.h"
```

```
#include <vector>
```

Include dependency graph for wander.h:



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



Classes

- class [wander](#)

7.21.1 Detailed Description

random wandering agents scenario

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

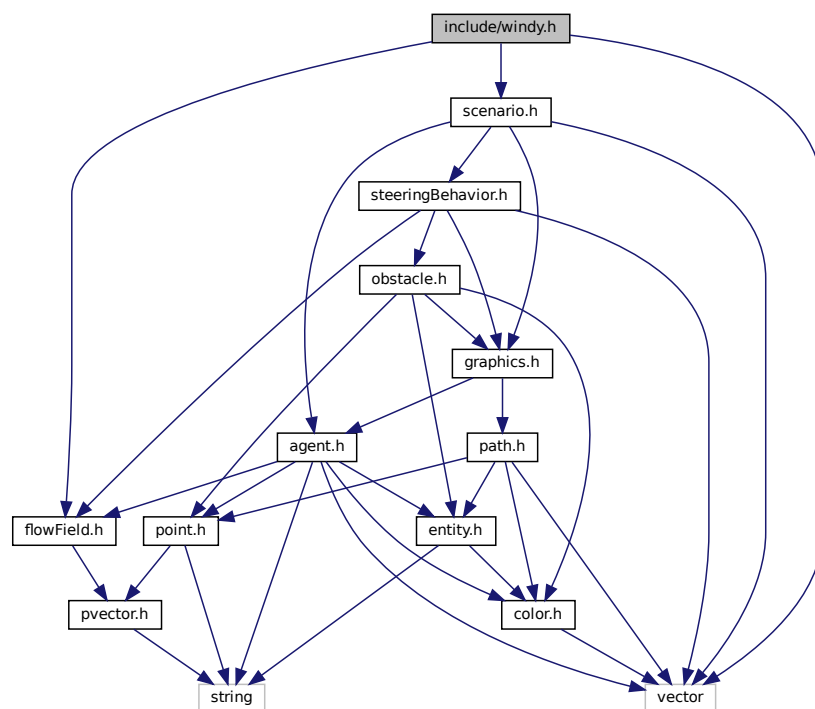
Date

15.05.2021

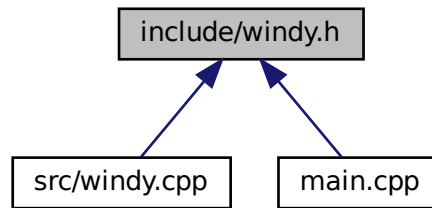
7.22 include/windy.h File Reference

windy air scenario

```
#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](#)

7.22.1 Detailed Description

windy air scenario

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

15.05.2021

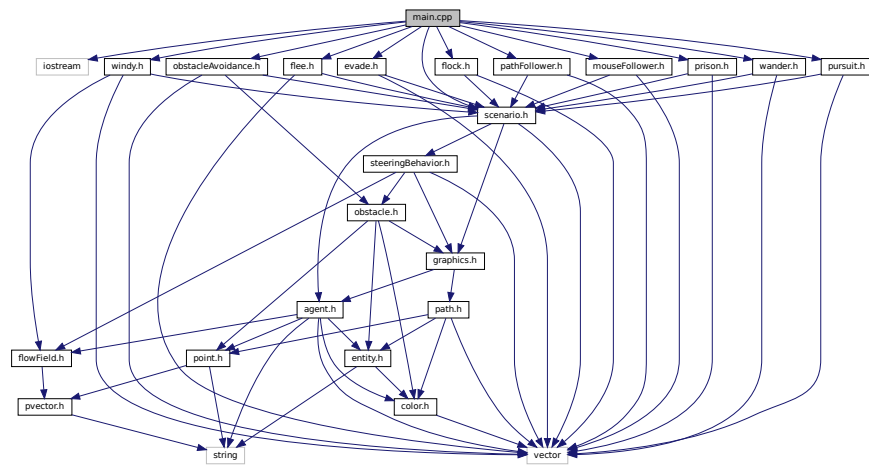
7.23 main.cpp File Reference

client code

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

```
#include "obstacleAvoidance.h"
```

Include dependency graph for main.cpp:



Functions

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

Variables

- int `mode`
specifies user selected scenario

7.23.1 Detailed Description

client code

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

15.05.2021

7.23.2 Function Documentation

7.23.2.1 main()

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

main routine

Definition at line 48 of file main.cpp.

```
48      {
49          menu();
50
51          scenario* sc;
52
53          if(mode == FOLLOW_MOUSE){
54              *sc = mouseFollower();
55          }
56          else if(mode == STAY_IN_FIELD){
57              *sc = prison();
58          }
59          else if(mode == IN_FLOW_FIELD){
60              *sc = windy();
61          }
62          else if(mode == WANDER){
63              *sc = wander();
64          }
65          else if(mode == PURSUIT){
66              *sc = pursuit();
67          }
68          else if(mode == FLEE){
69              *sc = flee();
70          }
71          else if(mode == EVADE){
72              *sc = evade();
73          }
74          else if(mode == FLOCK){
75              *sc = flock();
76          }
77          else if(mode == STAY_IN_PATH){
78              *sc = pathFollower();
79          }
80          else if(mode == AVOID_OBSTACLE){
81              *sc = obstacleAvoidance();
82          }
83
84          sc->initGL(&argc, argv);
85
86          return 0;
87      }
```

7.23.2.2 menu()

```
void menu ( )
```

displays menu

Definition at line 31 of file main.cpp.

```
31      {
32          cout << "Follow Mouse      : 1" << endl;
33          cout << "Stay in Field      : 2" << endl;
34          cout << "In Flow Field     : 3" << endl;
35          cout << "OBSTACLE AVOIDANCE : 4" << endl;
36          cout << "Stay in Path      : 5" << endl;
37          cout << "FLOCK             : 6" << endl;
38          cout << "WANDER            : 7" << endl;
39          cout << "FLEE              : 8" << endl;
40          cout << "PURSUIT           : 9" << endl;
41          cout << "EVADE             : 10" << endl;
42          cin >> mode;
43      }
```

7.23.3 Variable Documentation

7.23.3.1 mode

```
int mode
```

specifies user selected scenario

Definition at line 26 of file main.cpp.

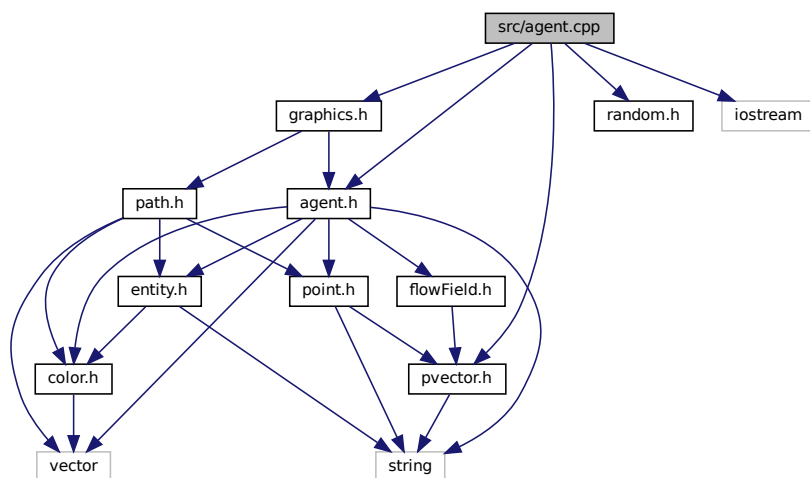
7.24 README.md File Reference

7.25 src/agent.cpp File Reference

implementation of the agent class

```
#include "agent.h"  
#include "pvector.h"  
#include "graphics.h"  
#include "random.h"  
#include <iostream>
```

Include dependency graph for agent.cpp:



7.25.1 Detailed Description

implementation of the agent class

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

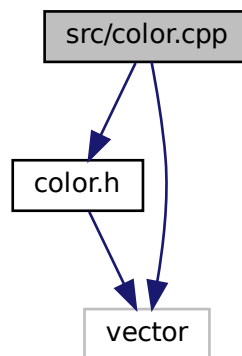
Date

14.05.2021

7.26 src/color.cpp File Reference

color class implementation

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



7.26.1 Detailed Description

color class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

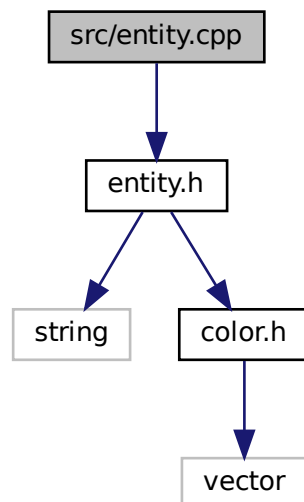
13.05.2021

7.27 src/entity.cpp File Reference

entity class implementation


```
#include "entity.h"
```

Include dependency graph for entity.cpp:



7.27.1 Detailed Description

entity class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

18.05.2021

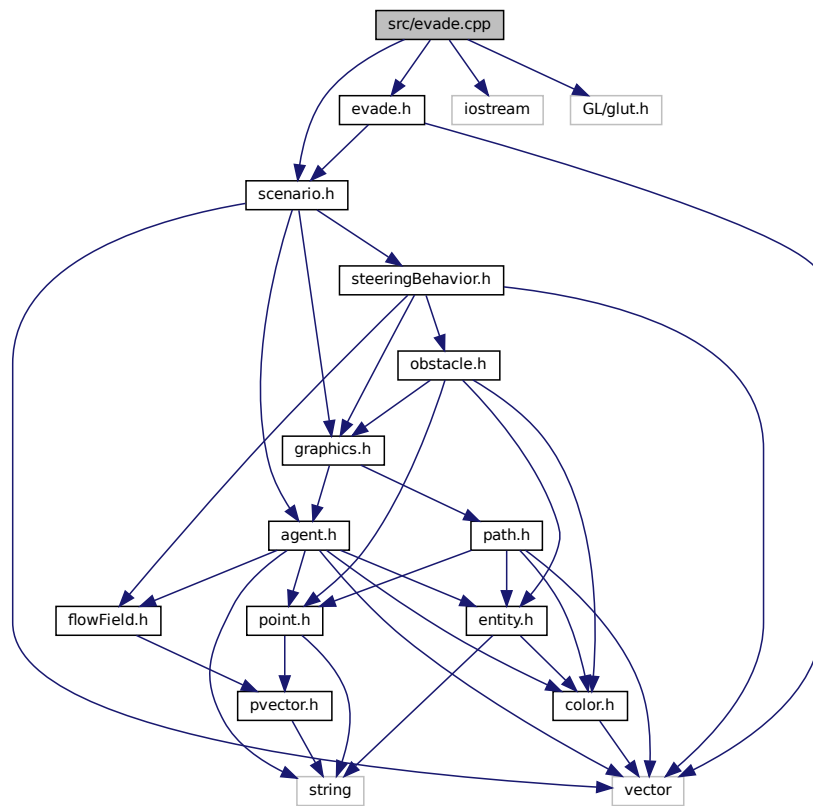
7.28 src/evade.cpp File Reference

evade class implementation

```
#include "scenario.h"
#include "evade.h"
#include <iostream>
```

```
#include <GL/glut.h>
```

Include dependency graph for evade.cpp:



7.28.1 Detailed Description

evade class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

15.05.2021

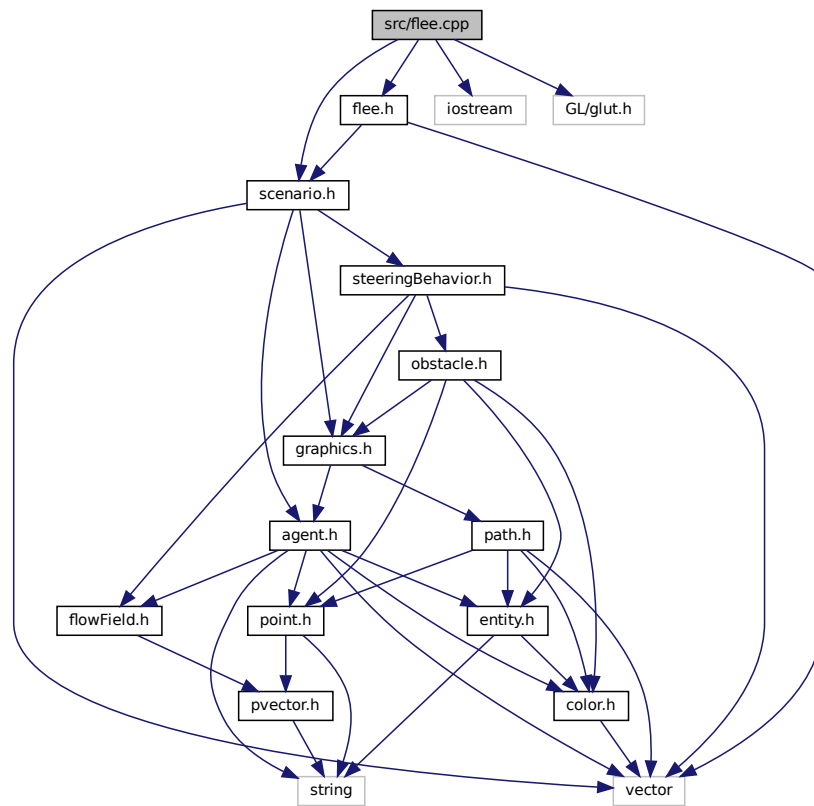
7.29 src/flee.cpp File Reference

flee class implementation

```
#include "scenario.h"
#include "flee.h"
#include <iostream>
```

```
#include <GL/glut.h>
```

Include dependency graph for flee.cpp:



7.29.1 Detailed Description

flee class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

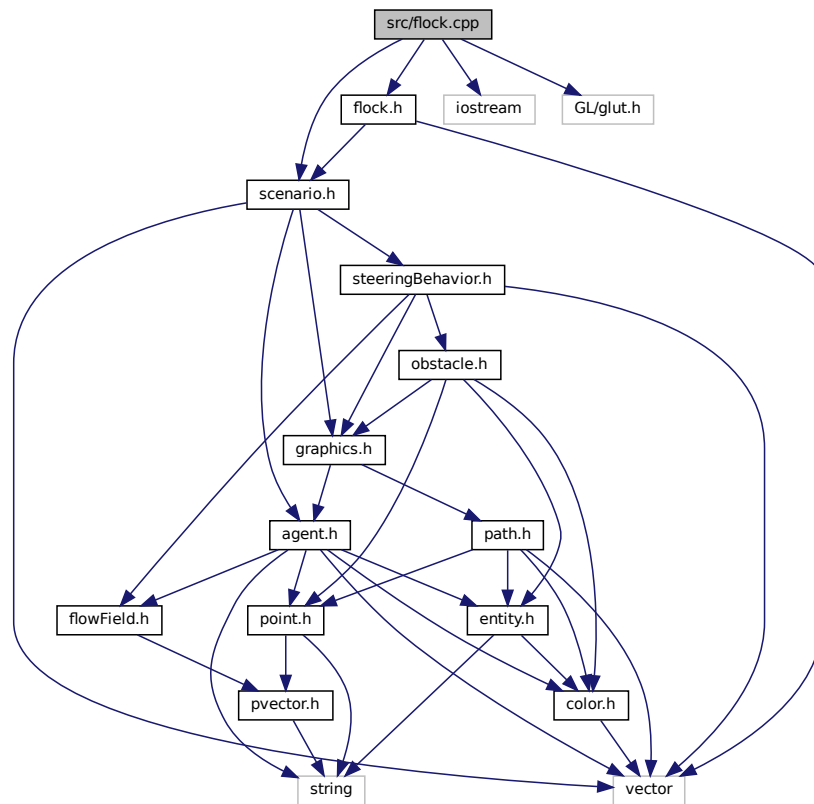
15.05.2021

7.30 src/flock.cpp File Reference

flock class implementation

```
#include "scenario.h"
#include "flock.h"
#include <iostream>
```

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



7.30.1 Detailed Description

flock class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

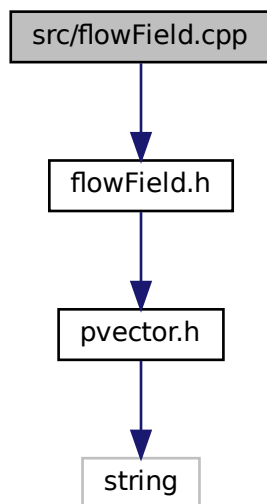
15.05.2021

7.31 src/flowField.cpp File Reference

[flowField](#) class implementation

```
#include "flowField.h"
```

Include dependency graph for flowField.cpp:



7.31.1 Detailed Description

`flowField` class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

13.05.2021

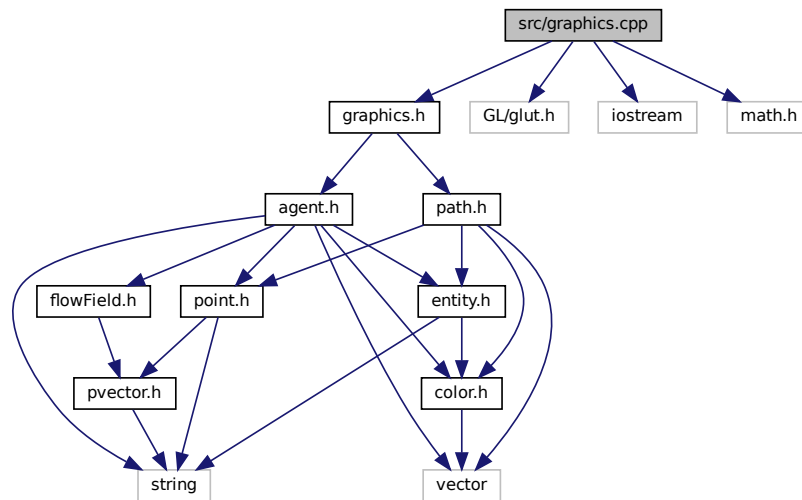
7.32 src/graphics.cpp File Reference

`graphics` class implementation

```
#include "graphics.h"  
#include <GL/glut.h>  
#include <iostream>
```

```
#include "math.h"
```

Include dependency graph for graphics.cpp:



7.32.1 Detailed Description

graphics class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

15.05.2021

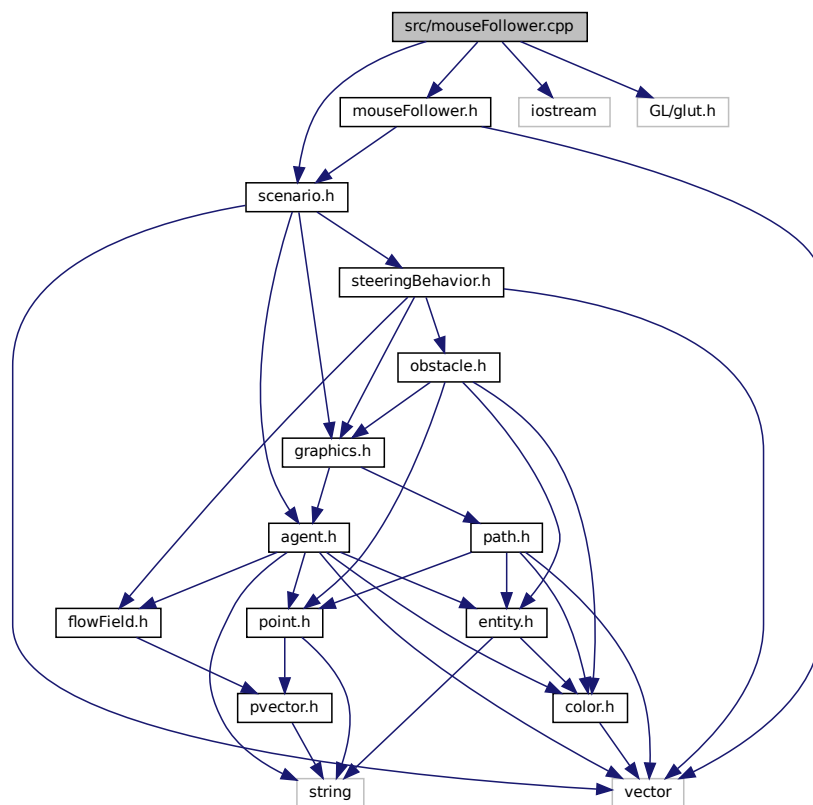
7.33 src/mouseFollower.cpp File Reference

`mouseFollower` class implementation

```
#include "scenario.h"
#include "mouseFollower.h"
#include <iostream>
```

```
#include <GL/glut.h>
```

Include dependency graph for mouseFollower.cpp:



7.33.1 Detailed Description

[mouseFollower](#) class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

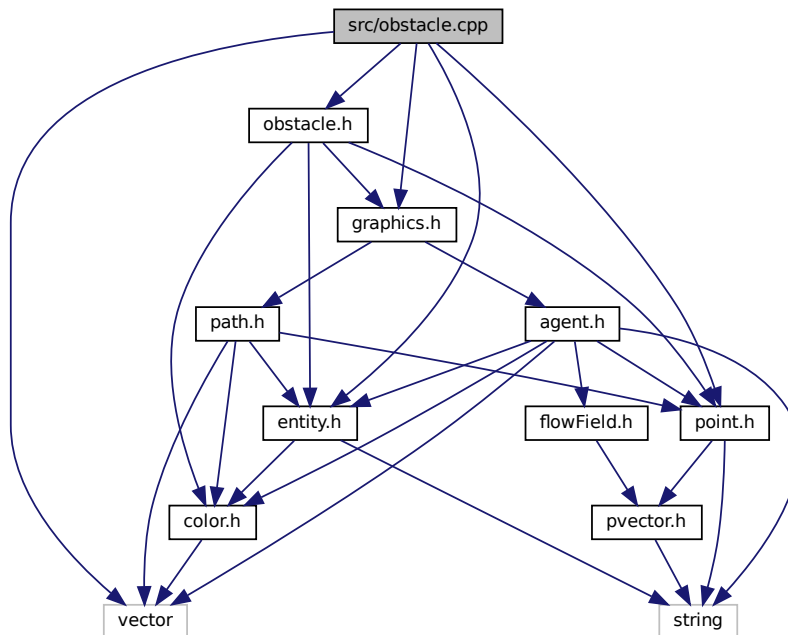
15.05.2021

7.34 src/obstacle.cpp File Reference

obstacle class implementation

```
#include "obstacle.h"
#include "graphics.h"
#include "point.h"
```

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



7.34.1 Detailed Description

obstacle class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

12.05.2021

7.35 src/obstacleAvoidance.cpp File Reference

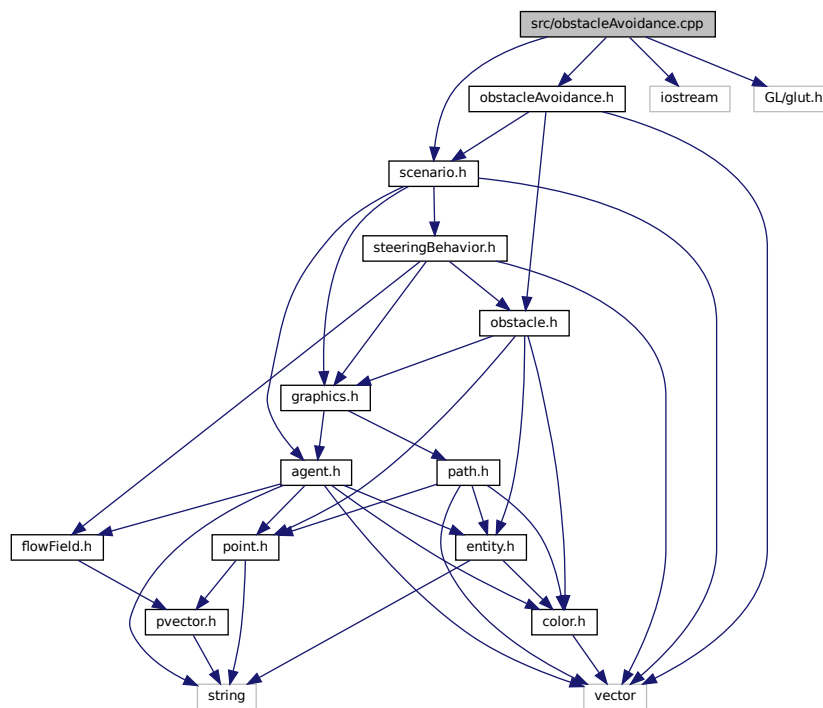
[obstacleAvoidance](#) class implementation

```
#include "scenario.h"
#include "obstacleAvoidance.h"
#include <iostream>
```



```
#include <GL/glut.h>
```

Include dependency graph for obstacleAvoidance.cpp:



7.35.1 Detailed Description

[obstacleAvoidance](#) class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

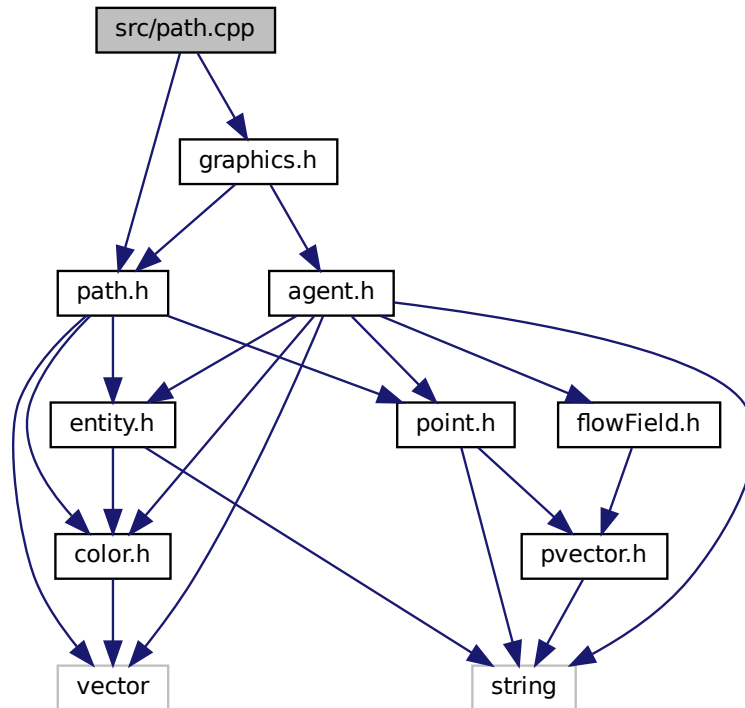
Date

15.05.2021

7.36 src/path.cpp File Reference

[path](#) class implementation

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



7.36.1 Detailed Description

path class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

12.05.2021

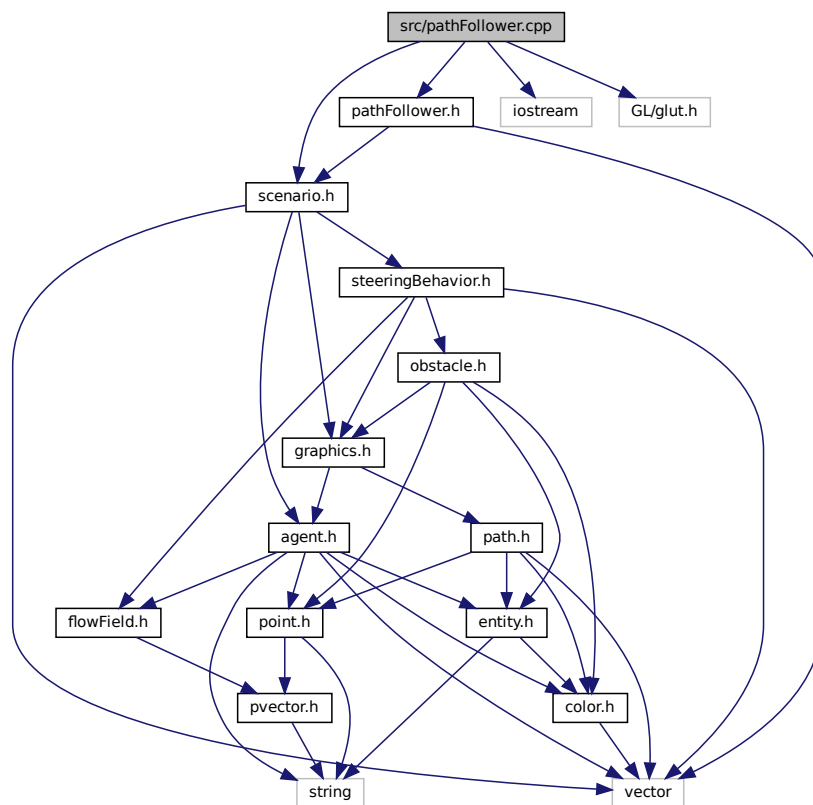
7.37 src/pathFollower.cpp File Reference

`pathFollower` class implementation

```
#include "scenario.h"
#include "pathFollower.h"
#include <iostream>
```

```
#include <GL/glut.h>
```

Include dependency graph for pathFollower.cpp:



7.37.1 Detailed Description

[pathFollower](#) class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

15.05.2021

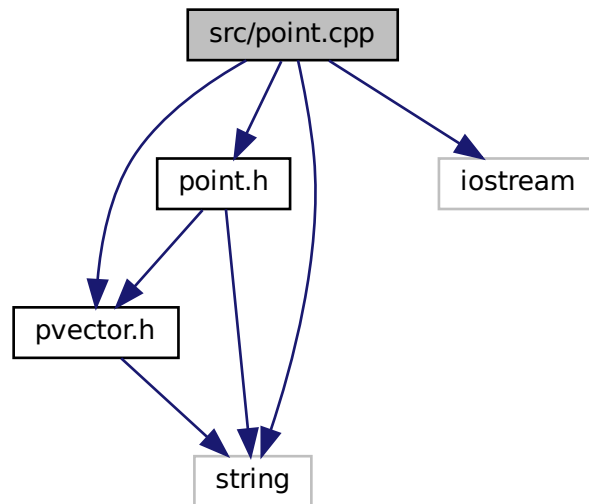
7.38 src/point.cpp File Reference

point class implementation file

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

```
#include <iostream>
```

Include dependency graph for point.cpp:



7.38.1 Detailed Description

point class implementation file

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

15.05.2021

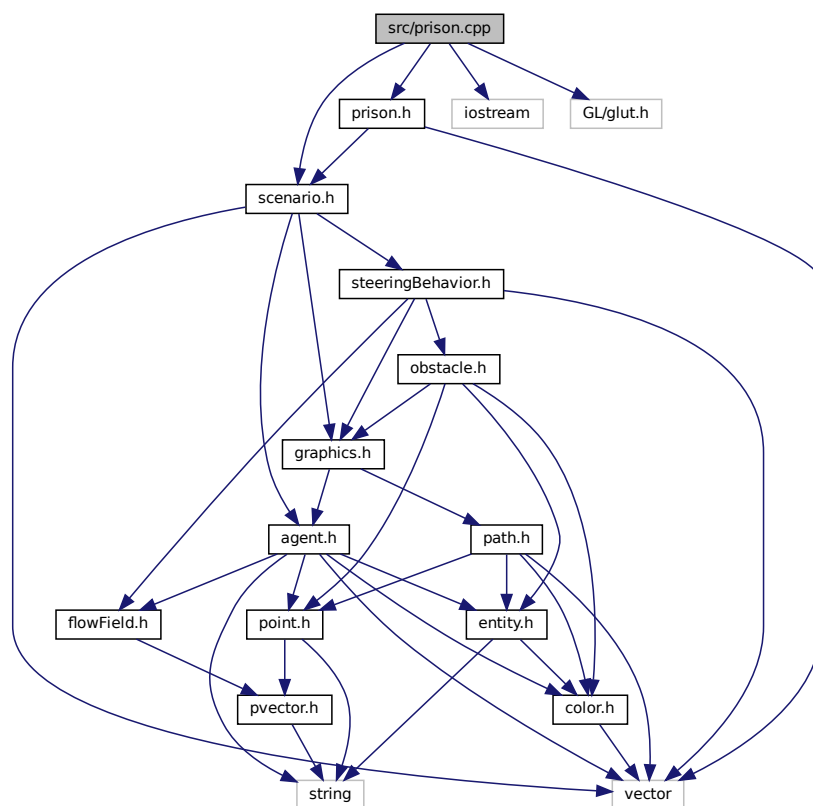
7.39 src/prison.cpp File Reference

prison class implementation

```
#include "scenario.h"
#include "prison.h"
#include <iostream>
```

```
#include <GL/glut.h>
```

Include dependency graph for prison.cpp:



Macros

- #define [WALL](#) 30
- #define [DISTANCE](#) 2

7.39.1 Detailed Description

prison class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

15.05.2021

7.39.2 Macro Definition Documentation

7.39.2.1 DISTANCE

```
#define DISTANCE 2
```

Definition at line 14 of file prison.cpp.

7.39.2.2 WALL

```
#define WALL 30
```

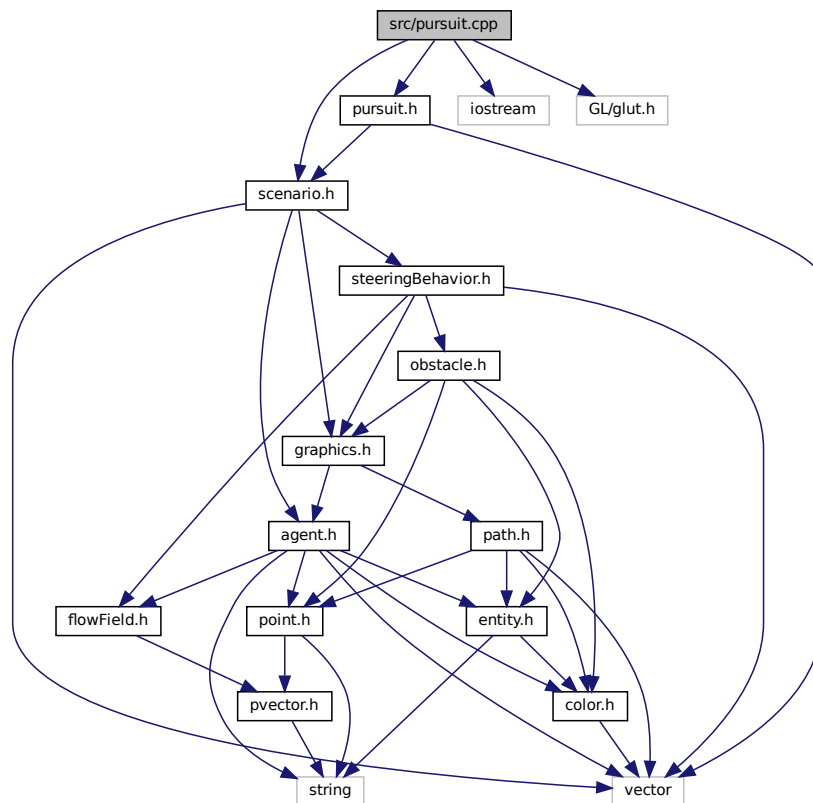
Definition at line 13 of file prison.cpp.

7.40 src/pursuit.cpp File Reference

prison class implementation

```
#include "scenario.h"
#include "pursuit.h"
#include <iostream>
#include <GL/glut.h>
```

Include dependency graph for pursuit.cpp:



7.40.1 Detailed Description

prison class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

15.05.2021

7.41 src/pvector.cpp File Reference

pvector class implementation

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

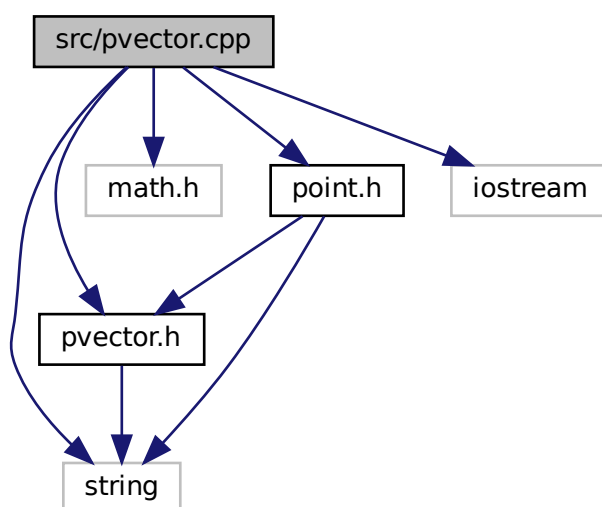
```
#include "math.h"
```

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

```
#include <iostream>
```

```
#include <string>
```

Include dependency graph for pvector.cpp:



7.41.1 Detailed Description

pvector class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

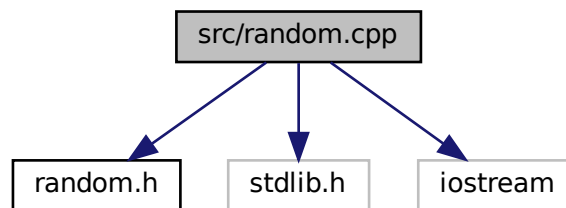
Date

15.05.2021

7.42 src/random.cpp File Reference

utility class for random operations

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



7.42.1 Detailed Description

utility class for random operations

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

15.05.2021

7.43 src/scenario.cpp File Reference

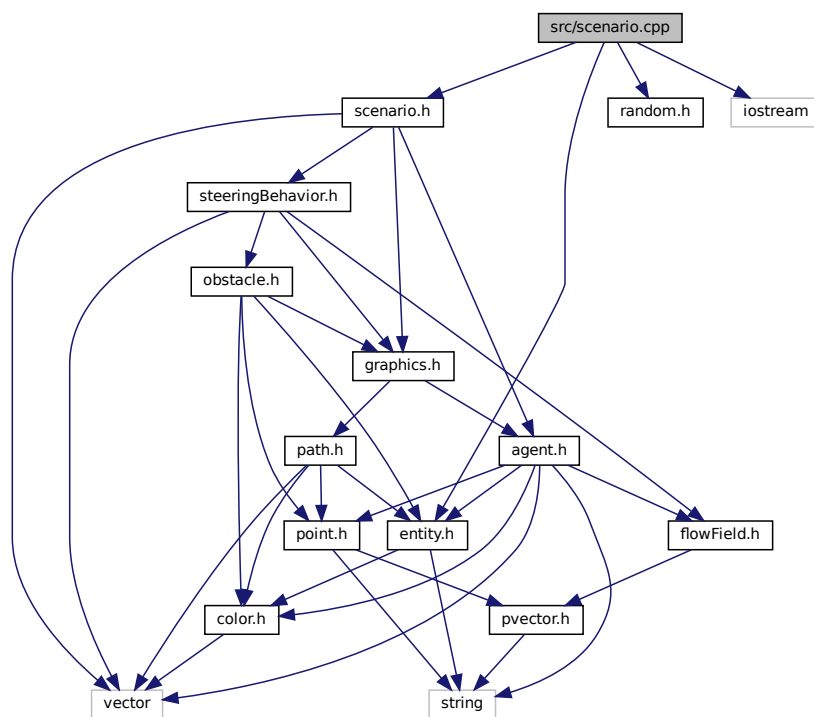
scenario base class implementation

```
#include "scenario.h"
#include "random.h"
#include "entity.h"
```



```
#include <iostream>
```

Include dependency graph for scenario.cpp:



Macros

- `#define MAX_NUMBER_OF_AGENTS 50`

7.43.1 Detailed Description

scenario base class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

15.05.2021

7.43.2 Macro Definition Documentation

7.43.2.1 MAX_NUMBER_OF_AGENTS

```
#define MAX_NUMBER_OF_AGENTS 50
```

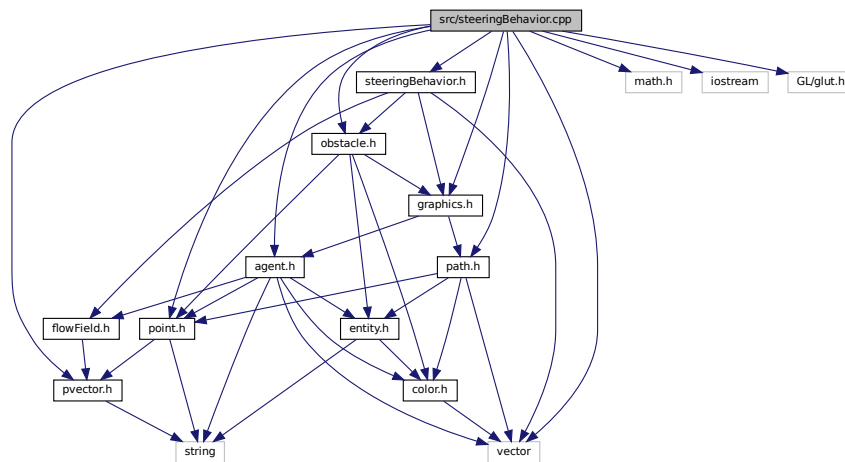
Definition at line 13 of file scenario.cpp.

7.44 src/steeringBehavior.cpp File Reference

implementation of autonomous steering behaviors

```
#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:



7.44.1 Detailed Description

implementation of autonomous steering behaviors

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

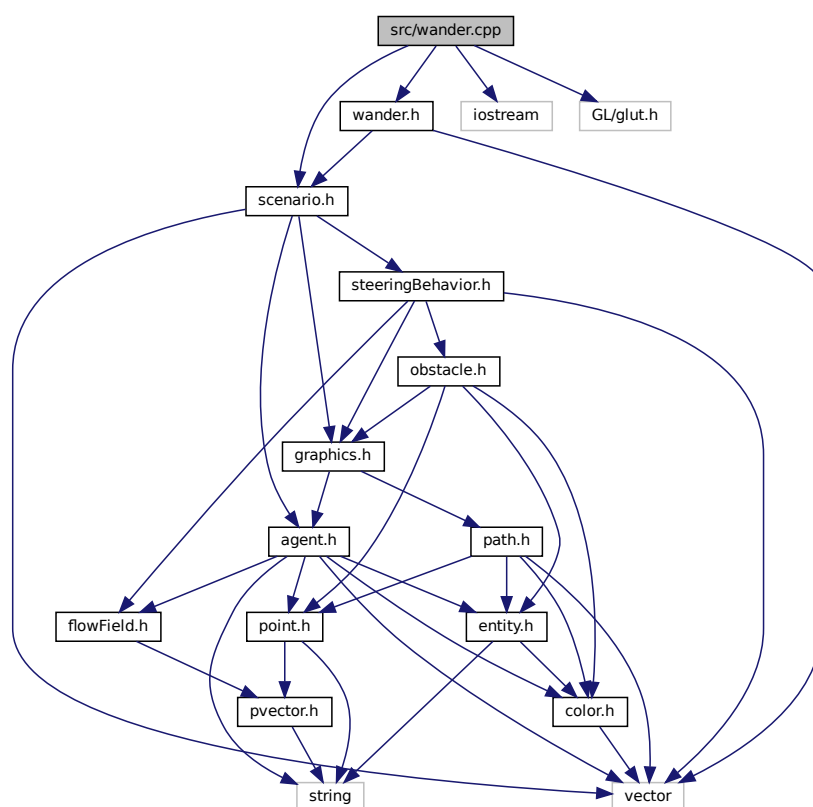
Date

15.05.2021

7.45 src/wander.cpp File Reference

wander class implementation

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



7.45.1 Detailed Description

wander class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

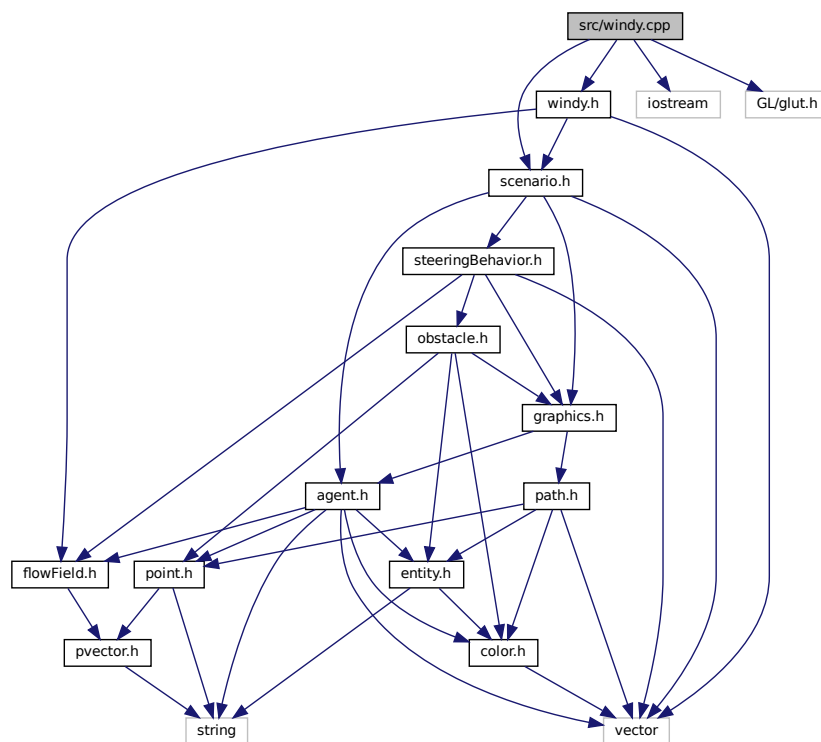
Date

15.05.2021

7.46 src/windy.cpp File Reference

windy class implementation

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



7.46.1 Detailed Description

windy class implementation

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

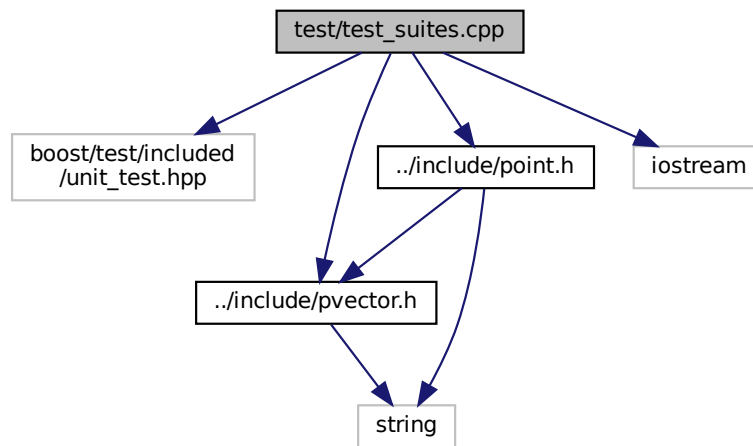
15.05.2021

7.47 test/test_suites.cpp File Reference

unit test suites

```
#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)`
pvector magnitude test case
- `BOOST_AUTO_TEST_CASE (s1t2)`
pvector mul test case
- `BOOST_AUTO_TEST_CASE (s1t3)`
pvector div test case
- `BOOST_AUTO_TEST_CASE (s1t4)`
pvector dotproduct test case
- `BOOST_AUTO_TEST_CASE (s1t5)`
pvector angle between vectors test case
- `BOOST_AUTO_TEST_CASE (s1t6)`
pvector get vector angle test case
- `BOOST_AUTO_TEST_CASE (s1t7)`
pvector normalize test case
- `BOOST_AUTO_TEST_CASE (s1t8)`

- pvector limit test case*
- [BOOST_AUTO_TEST_CASE](#) (s1t9)
- pvector overloaded operators test case*
- [BOOST_AUTO_TEST_CASE](#) (s2t1)
- point multiplication test case*
- [BOOST_AUTO_TEST_CASE](#) (s2t2)
- point division test case*
- [BOOST_AUTO_TEST_CASE](#) (s2t3)
- point overloaded operators test case*

7.47.1 Detailed Description

unit test suites

Author

Mehmet Rıza Öz - mehmetrizaoz@gmail.com

Date

15.05.2021

7.47.2 Macro Definition Documentation

7.47.2.1 BOOST_TEST_MODULE

```
#define BOOST_TEST_MODULE test_suites
```

Definition at line 8 of file test_suites.cpp.

7.47.3 Function Documentation

7.47.3.1 BOOST_AUTO_TEST_CASE() [1/12]

```
BOOST_AUTO_TEST_CASE (
    s1t1 )
```

pvector magnitude test case

Definition at line 22 of file test_suites.cpp.

```
23 {
24     pvector p1 = pvector(0, 4);
25     pvector p2 = pvector(3, 0);
26     pvector p3 = p1 + p2;
27     BOOST_CHECK(p3.magnitude() == 5);
28 }
```

7.47.3.2 BOOST_AUTO_TEST_CASE() [2/12]

```
BOOST_AUTO_TEST_CASE (
    slt2 )
```

pvector mul test case

Definition at line 33 of file test_suites.cpp.

```
34 {
35     pvector p1 = pvector(1, 1);
36     p1.mul(3);
37     pvector p2 = pvector(3, 3);
38     BOOST_CHECK(p1 == p2);
39 }
```

7.47.3.3 BOOST_AUTO_TEST_CASE() [3/12]

```
BOOST_AUTO_TEST_CASE (
    slt3 )
```

pvector div test case

Definition at line 44 of file test_suites.cpp.

```
45 {
46     pvector p1 = pvector(5, 5);
47     p1.div(5);
48     pvector p2 = pvector(1, 1);
49     BOOST_CHECK(p1 == p2);
50 }
```

7.47.3.4 BOOST_AUTO_TEST_CASE() [4/12]

```
BOOST_AUTO_TEST_CASE (
    slt4 )
```

pvector dotproduct test case

Definition at line 55 of file test_suites.cpp.

```
56 {
57     pvector p1 = pvector(1, 4);
58     pvector p2 = pvector(3, 2);
59     float dotProduct = p1.dotProduct(p2);
60     BOOST_CHECK(dotProduct == 11);
61 }
```

7.47.3.5 BOOST_AUTO_TEST_CASE() [5/12]

```
BOOST_AUTO_TEST_CASE (
    slt5 )
```

pvector angle between vectors test case

Definition at line 66 of file test_suites.cpp.

```
67 {
68     pvector p1 = pvector(10, 10);
69     pvector p2 = pvector(0, 10);
70     float angle = p1.angleBetween(p2);
71     BOOST_CHECK(angle == 45);
72 }
```

7.47.3.6 BOOST_AUTO_TEST_CASE() [6/12]

```
BOOST_AUTO_TEST_CASE (
    slt6 )
```

pvector get vector angle test case

Definition at line 77 of file test_suites.cpp.

```
78 {
79     pvector p1 = pvector(3, 4);
80     float angle = p1.getAngle();
81     BOOST_CHECK(angle < 53.2 && angle > 52.8);
82 }
```

7.47.3.7 BOOST_AUTO_TEST_CASE() [7/12]

```
BOOST_AUTO_TEST_CASE (
    slt7 )
```

pvector normalize test case

Definition at line 87 of file test_suites.cpp.

```
88 {
89     pvector p1 = pvector(2, 2);
90     p1.normalize();
91     float range = 0.01;
92     BOOST_CHECK_CLOSE_FRACTION(0.707, p1.x, range);
93     BOOST_CHECK_CLOSE_FRACTION(0.707, p1.y, range);
94 }
```

7.47.3.8 BOOST_AUTO_TEST_CASE() [8/12]

```
BOOST_AUTO_TEST_CASE (
    slt8 )
```

pvector limit test case

Definition at line 99 of file test_suites.cpp.

```
100 {
101     pvector p1 = pvector(2, 2);
102     p1.limit(3);
103     float range = 0.01;
104     BOOST_CHECK_CLOSE_FRACTION(2.12, p1.x, range);
105     BOOST_CHECK_CLOSE_FRACTION(2.12, p1.y, range);
106 }
```


7.47.3.9 BOOST_AUTO_TEST_CASE() [9/12]

```
BOOST_AUTO_TEST_CASE (
    s1t9 )
```

pvector overloaded operators test case

Definition at line 111 of file test_suites.cpp.

```
112 {
113     pvector p1 = pvector(1, 1);
114     p1 += pvector(1,1);
115     BOOST_CHECK(p1 == pvector(2,2));
116     p1 = pvector(1,1) + pvector(3,3);
117     BOOST_CHECK(p1 == pvector(4,4));
118     p1 = pvector(4,1) - pvector(3,3);
119     BOOST_CHECK(p1 == pvector(1,-2));
120     p1 = pvector(4,1) - point(3,3);
121     BOOST_CHECK(p1 == pvector(1,-2));
122     p1 = pvector(4,1) + point(3,3);
123     BOOST_CHECK(p1 == pvector(7,4));
124 }
```

7.47.3.10 BOOST_AUTO_TEST_CASE() [10/12]

```
BOOST_AUTO_TEST_CASE (
    s2t1 )
```

point multiplication test case

Definition at line 133 of file test_suites.cpp.

```
134 {
135     point p1 = point(1, 1);
136     p1.mul(3);
137     point p2 = point(3, 3);
138     BOOST_CHECK(p1 == p2);
139 }
```

7.47.3.11 BOOST_AUTO_TEST_CASE() [11/12]

```
BOOST_AUTO_TEST_CASE (
    s2t2 )
```

point division test case

Definition at line 144 of file test_suites.cpp.

```
145 {
146     point p1 = point(4, 4);
147     p1.div(4);
148     point p2 = point(1, 1);
149     BOOST_CHECK(p1 == p2);
150 }
```

7.47.3.12 BOOST_AUTO_TEST_CASE() [12/12]

```
BOOST_AUTO_TEST_CASE (
    s2t3 )
```

point overloaded operators test case

Definition at line 155 of file test_suites.cpp.

```
156 {
157     point p1 = point(1,1) + point(3,3);
158     BOOST_CHECK(p1 == point(4,4));
159     p1 = point(1,1) + pvector(3,3);
160     BOOST_CHECK(p1 == point(4,4));
161     pvector p2 = point(1,1) - point(3,3);
162     BOOST_CHECK(p2 == pvector(-2,-2));
163 }
```


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