Architectural Home Plan Design Supporting System with Knowledge Base Inspection

Interim Progress

R.P.M.C.Rajapaksha
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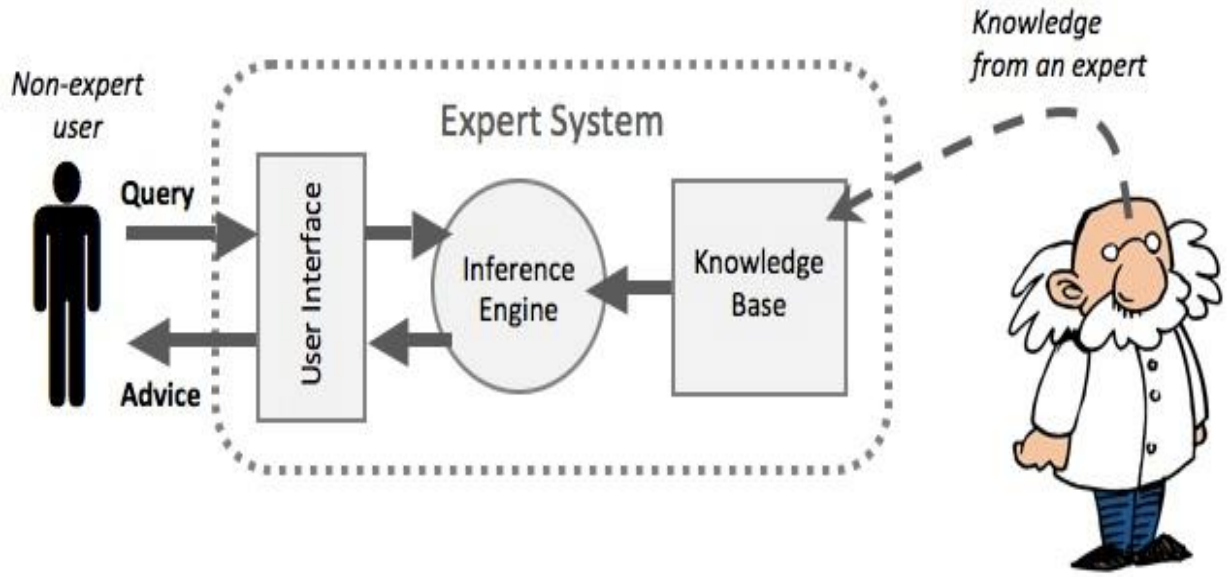
2298

Knowledge Base Implementation



Geometrical Rules

Architectural Rules

Legal Rules

Summary of Implemented Geometrical Rules

- ✓ Define a Line
- ✓ Define a Polygon

  Just a set of polygons does not represent a house
- ✓ Define interconnection of two polygons

  Interconnected polygons should not be overlapped

Knowledge Base Implementation Up to Now

Geometrical Rules

Geometrical Rule Terminology Addressed

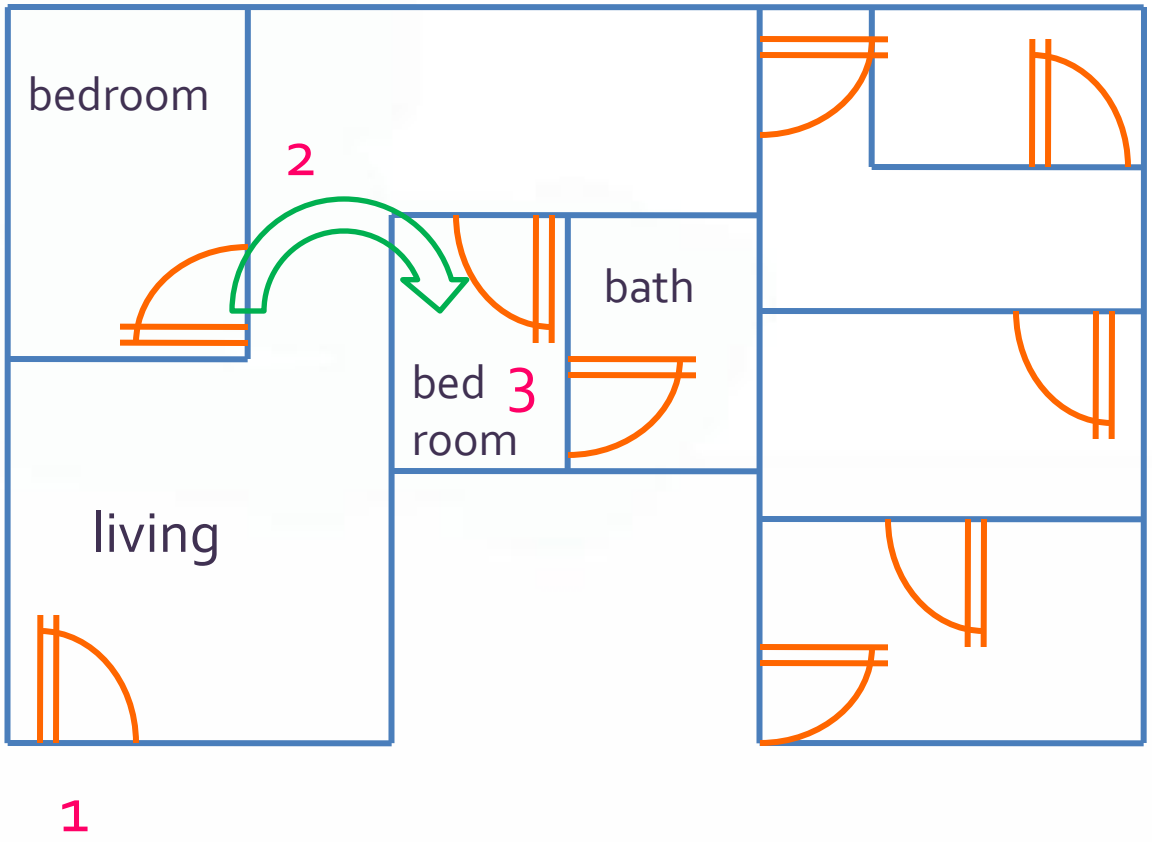
1. There should be a path to move from any polygon to any other polygon
2. A polygon should satisfy a minimum, maximum area and a minimum width
3. Windows should be placed properly

1. There should be a path to move from any polygon to any other (cont)

```
path(X,Y,[],N) :- adjacent(X,Y), noBothRoomPrivate(X,Y).
path(X,Y,[Z|I],N) :- N>0, N2 is N-1, adjacent(X,Z), noBothRoomPrivate(X,Z), path(Z,Y,I,N2).
```

1. There should be at least one open path in the boundary of the house. Eg: as the main door
2. There should be more than one step in the path between two private areas and the middle step should be through a public area
3. In a special case such as attached bathroom, bathroom should be reached only through the particular attached area

1. There should be a path to move from any polygon to any other (cont)



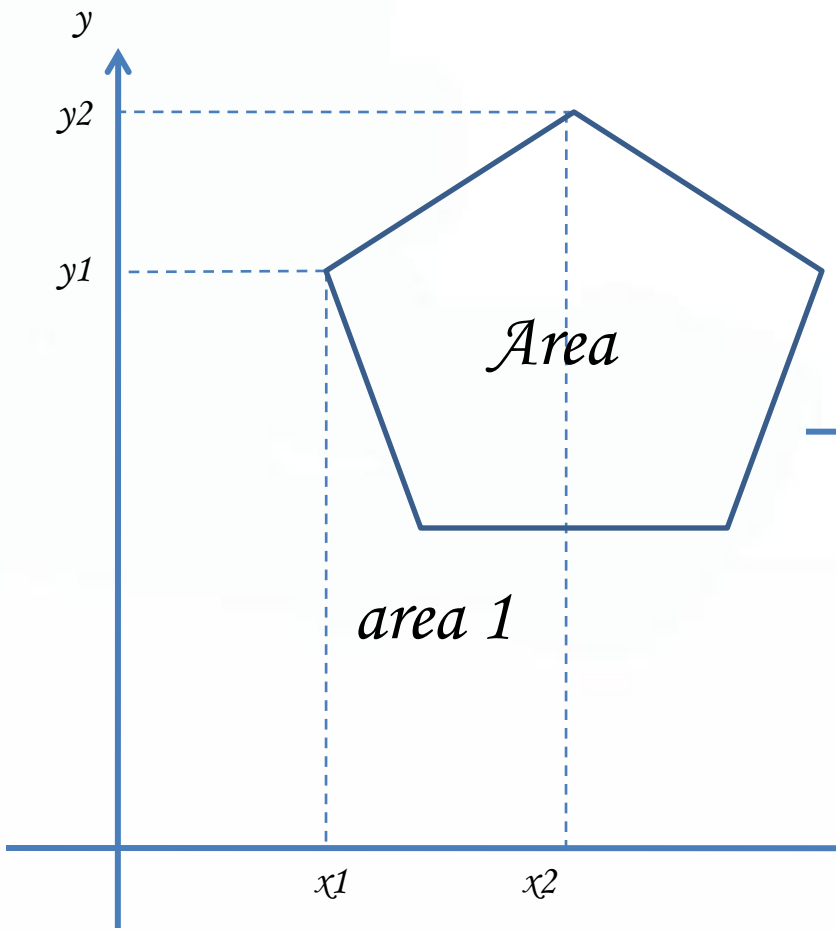
2. A polygon should satisfy a minimum, maximum area

Why

To check whether a polygon satisfies the minimum and maximum area required by a specific type of a polygon

Eg : minimum area required by a bedroom : 11 square meters

Find the Area of a Polygon



$$Y = (y1 + y2) / 2$$

$$X = (x2 - x1)$$

$$area\ 1 = X * Y$$

$$Area = area\ 1 + area\ 2 + area\ 3 + area\ 4 + area\ 5$$

2. A polygon should satisfy a minimum width

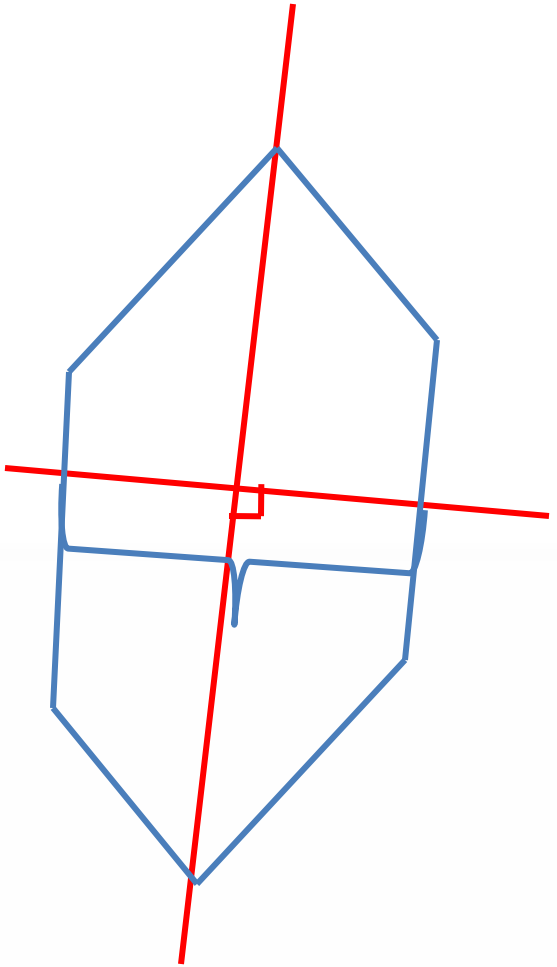
Why

To check whether a polygon satisfies the minimum width required by a specific type of a polygon

Eg : minimum width required by a bedroom : 3 meters

Find the Width of a Polygon

1. Get the points which have maximum distance from each other
2. Get the lines perpendicular to above line
3. Get the maximum length line as the width of the polygon



3. Windows should be placed properly

1. Windows should be placed in the boundary of the house

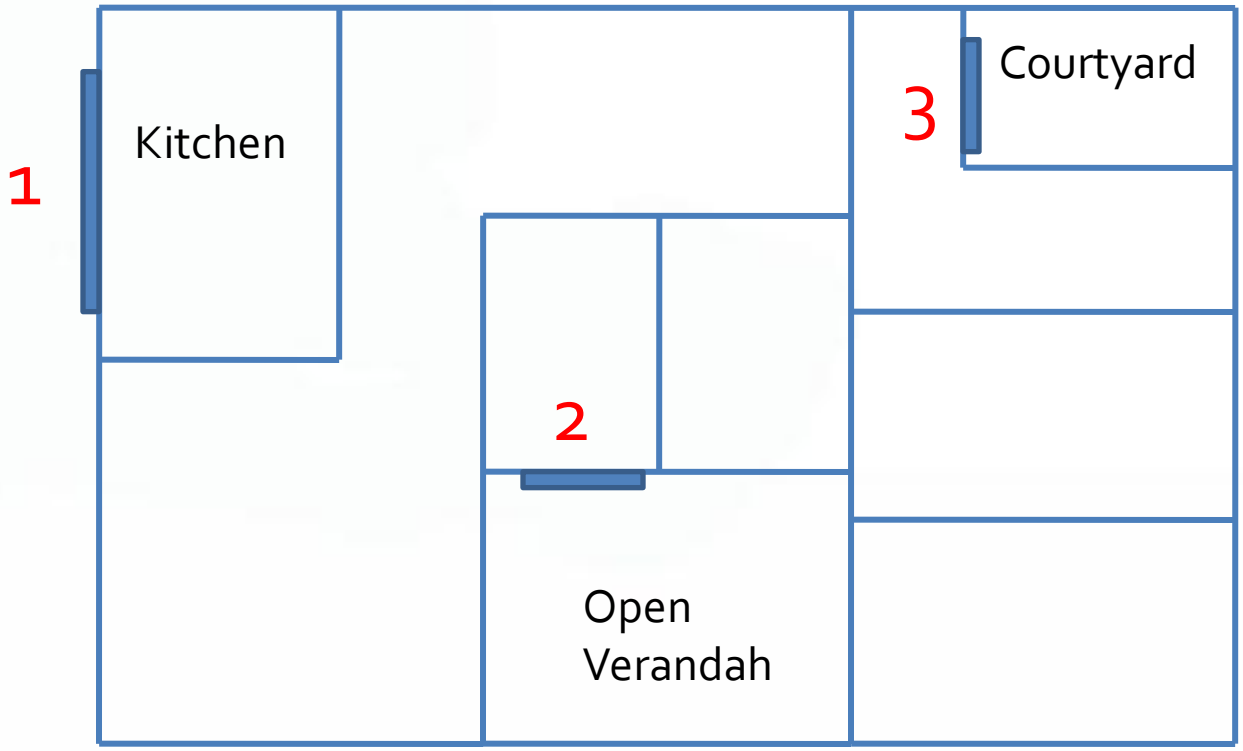
   Or

2. On a line of a polygon which contains open boundary lines of the house

   Or

3. On a polygon which does not have a roof

3. Windows should be placed properly (cont)



Knowledge Base Implementation Up to Now

Architectural Rules Basic Terminology

1. Find the Direction of a Polygon with respect to the centroid of the house

1. Find the Direction of a Polygon with respect to the centroid of the house

Why

To find the

Rooms position

Main door position

Windows position

1. Find the center is allowable for regular polygons
2. But for irregular polygons we need to calculate the centroid of the polygon

Architectural Terminologies

Main Door

Ventilation

Kitchen

North

Wash Room

West

Main Door

East

Study Room

South

Bed Room

Kitchen

1. Find the Direction of a Polygon (cont)

Find the centroid of the house

Find the centroid of the polygon

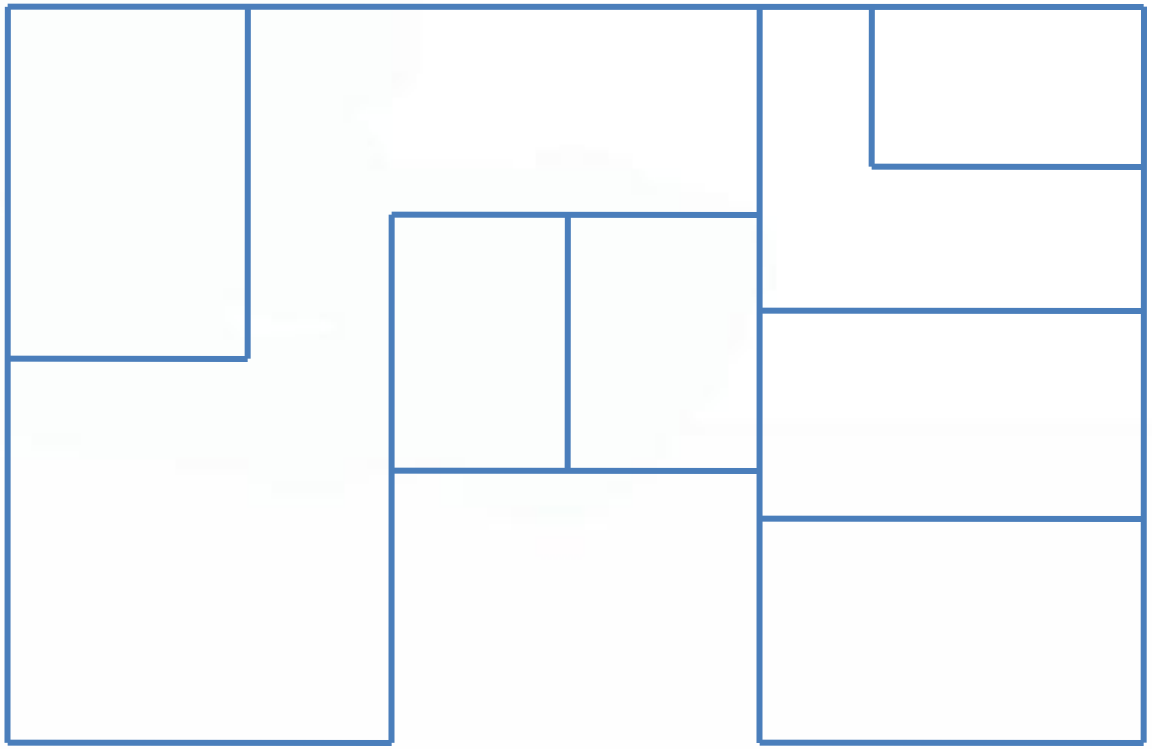
Assume North Direction

Calculate the tangent value

According to the tangent value determine the direction of the polygon

1. Find the Direction of a Polygon (cont)

Take the list of polygons of the house



1. Find the Direction of a Polygon (cont)

Remove the inner lines of the polygon

1. Take the list of lines of the polygons and delete the common lines and get the boundary of the polygon
2. Then order the list of lines and calculate the centroid

Prolog Code

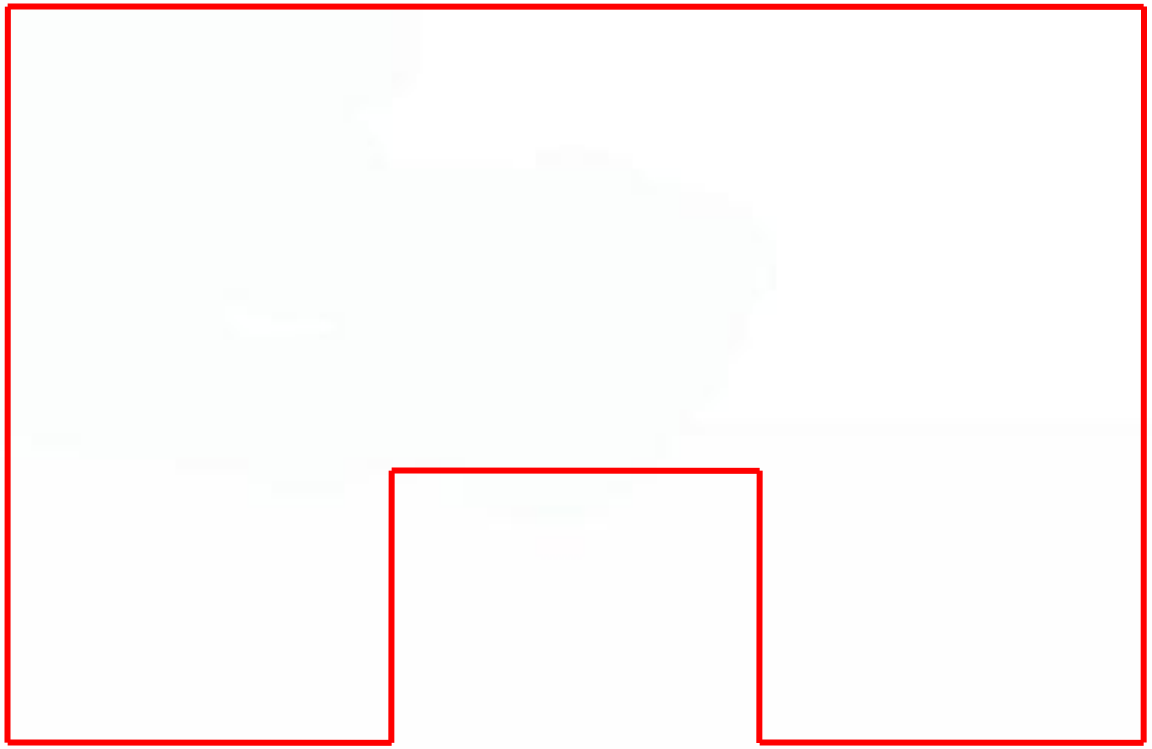
```
housePlanLineList([P1,P2], HL) :-  append(P1, P2, HL).
housePlanLineList([P1|[P2|PN]], HL) :-  append(P1, P2, L1), housePlanLineList(PN, L2), append(L1,L2,HL).

boundary([],R,R).
boundary([H|L],T,R) :- occurrences(L,H,N), N>=1, deleteMe(H,T,R1), deleteMe(H,R1,R2), boundary(L,R2,R).
boundary([H|L],T,R) :- occurrences(L,H,N), N<1, boundary(L,T,R).

occurrences([],_,0).
occurrences([X|Y],X,N):- occurrences(Y,X,W),N is W + 1.
occurrences([X|Y],Z,N):- occurrences(Y,Z,N),X\=Z.
```

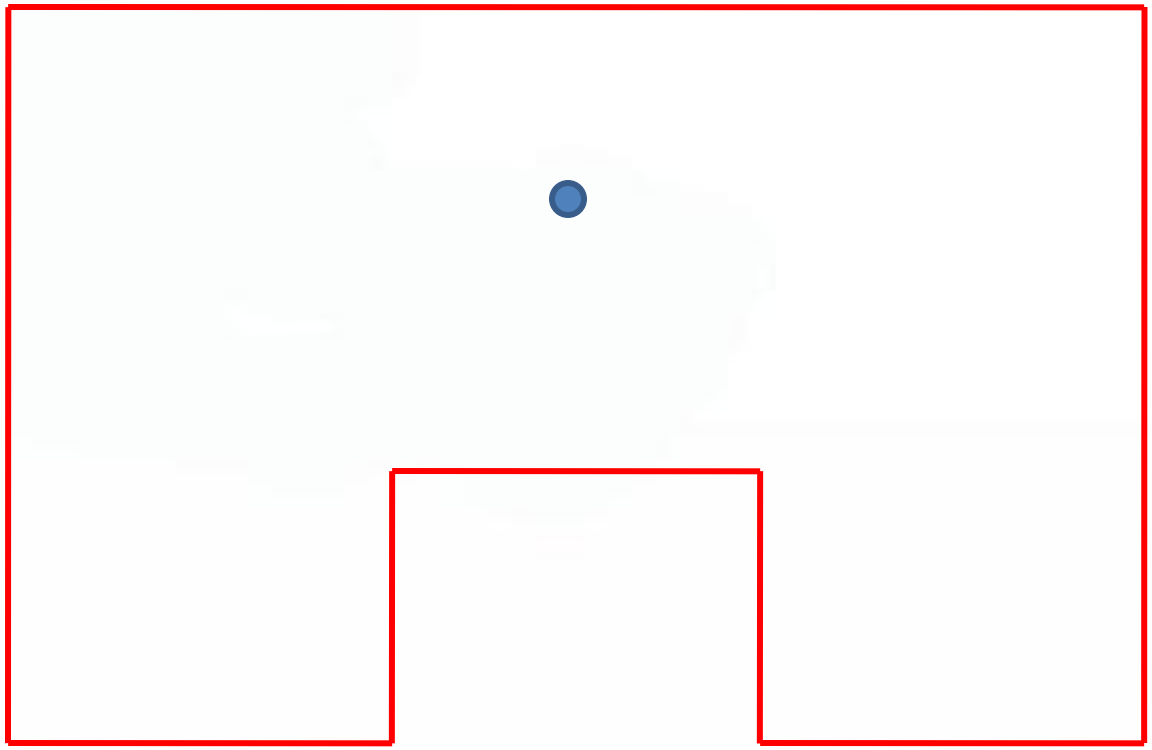
1. Find the Direction of a Polygon (cont)

Remove the inner lines of the polygon



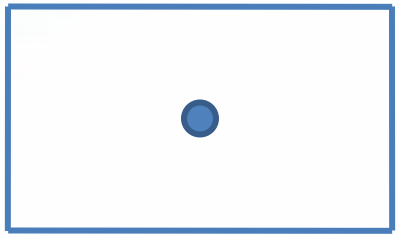
1. Find the Direction of a Polygon (cont)

Find the centroid of the house



1. Find the Direction of a Polygon (cont)

Find the centroid of the specific polygon



1. Find the Direction of a Polygon (cont)

Find the centroid of a polygon - Equation

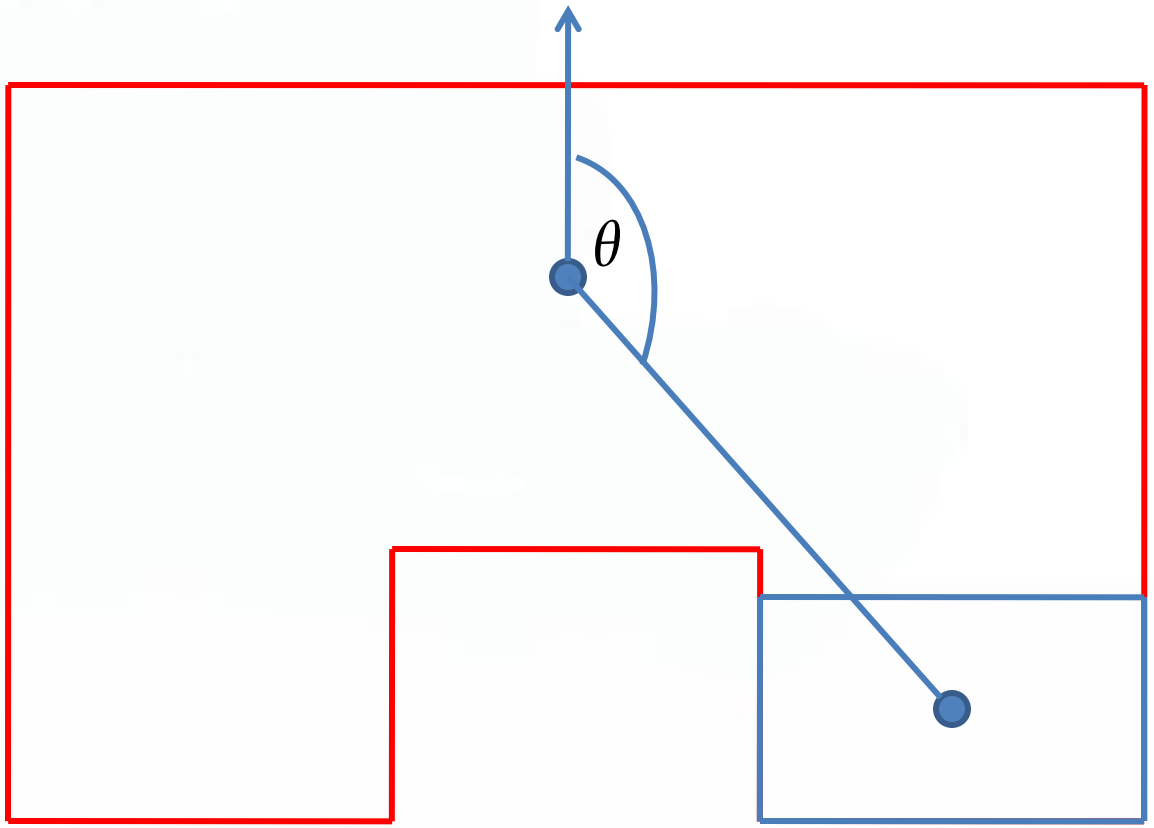
$$C_x = \frac{1}{6A}\sum_{i=0}^{n-1}(x_i + x_{i+1})(x_i\ y_{i+1} - x_{i+1}\ y_i)$$

$$C_y = \frac{1}{6A}\sum_{i=0}^{n-1}(y_i + y_{i+1})(x_i\ y_{i+1} - x_{i+1}\ y_i)$$

and where *A* is the polygon's signed area,

$$A = \frac{1}{2}\sum_{i=0}^{n-1}(x_i\ y_{i+1} - x_{i+1}\ y_i)$$

1. Find the Direction of a Polygon (cont)



1. Find the Direction of a Polygon (cont)

$Tan\ \theta$	$\theta > 180$	$\theta°$
0	0	0
0.01745506	no	1
0.03492077	no	2
….	no	….
1	no	45
∞	no	90
-1	no	135
0	180	180
1	yes	225
∞	yes	270
-1	yes	315
0	360	360

1. Find the Direction of a Polygon (cont)

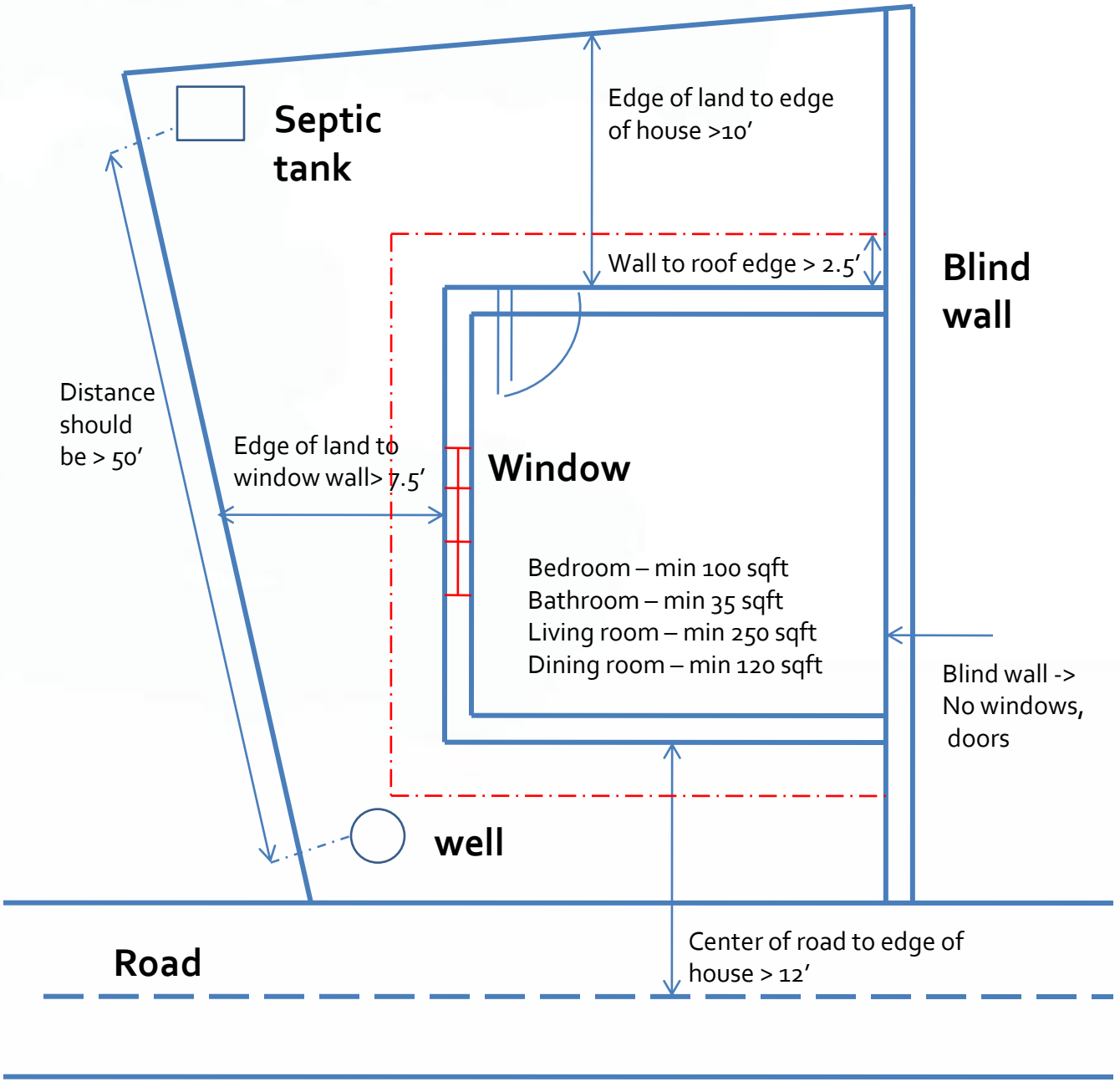
$\theta°$	*Direction*
22.5 – 67.5	North East
67.5 – 112.5	East
112.5 – 157.5	South East
157.5 – 202.5	South
202.5 – 247.5	South West
247.5 – 292.5	West
292.5 – 337.5	North West
337.5 – 360 or 0 – 22.5	North
270	West
315	North West
360	North

Knowledge Base Implementation Up to Now

Legal Rules Basic Terminology

1. Find the distances from the edges

Legal Rules


Septic tank
Edge of land to edge of house >10'
Wall to roof edge > 2.5'
Blind wall
Distance should be > 50'
Edge of land to window wall> 7.5'
Window
Bedroom – min 100 sqft
Bathroom – min 35 sqft
Living room – min 250 sqft
Dining room – min 120 sqft
Blind wall -> No windows, doors
well
Road
Center of road to edge of house > 12'

1. Find the distances from the edges

1. The boundary of the land should be represented by a polygon
2. The house should be inside the above polygon
3. The house can have walls in the margin of the land polygon and it is called as blind wall

Next…

Bla bla bla

Thank You