Structured input to HIJSON
Towards indoor mapping and IoT modeling *

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Abstract

This module aims to prototype the process of entering geometric data representing a complex building, to provide them explicit semantic and a hierarchical model. The generated LAR structures [DPS14, PDFJ15] are finally output to HIJSON format, an experimental data format extending GEOJSON for applications of indoor mapping and the Internet-of-Things. In HIJSON a strongly simplied building model, yet sufficient for useful purposes, accomodates the knowledge concerning the use models of the building and the set of interior devices and their connection.

Contents

*This document is part of the *Linear Algebraic Representation with CoChains* (LAR-CC) framework [CL13]. November 25, 2015

1 Introduction

2 Implementation

2.1 Input of geometry from external drawings

File input and computation of cellular complex The modeling process starts with the input of a `.svg` file, the W3C standard for 2D vector graphics on the web. The file must only contain (by now) `<rect>` and `<line>` graphics primitives. The geometric data generate the partition of the plane induced by an arrangment of intersecting lines. The arrangement of (fragmented) lines is finally transformed into a 2D *LAR model*, made by the triple `V,FV,EV` of vertices, faces and edges. We notice the the LAR input is normalized by the `larFromLines` function: all vertices in `V` are transformed in the standard plane interval $[0,1]^2$.

⟨SVG file input and computation of cellular complex 2a⟩ ≡

```
""" File input and computation of cellular complex """
def svg2lar(filename):
    lines = svg2lines(filename)
    larModel = larFromLines(lines)
    V,FV,EV = larModel
    return larModel
◇
```

Macro referenced in 5a.

2.2 Emulation of interactive graphics input

In this section two functions are given to emulate two graphics input primitives, respectively.

Emulation of input from "selection box" The function accepts as input the LAR model `V,FV,EV` and a `queryBox` given in normalized coordinates. It returns `vertexSubset` $\subseteq$ `V`, `faceSubset` $\subseteq$ `FV`, `edgeSubset` $\subseteq$ `EV`.

⟨Emulation of input from "selection box" 2b⟩ ≡

```
""" Emulation of input from ‘‘selection box’’ over a LAR normalized representation """
from scipy import spatial

def subComplexInBox(V,FV,EV,queryBox):
    (xmin,ymin),(xmax,ymax) = queryBox
    if xmin > xmax: xmin,xmax = xmax,xmin
    if ymin > ymax: ymin,ymax = ymax,ymin
    vdict = dict([(vcode(vert),k) for k,vert in enumerate(V)])
```

```
    vertexSubset = [vdict[vcode((x,y))] for x,y in V if xmin<=x<=xmax and ymin<=y<=ymax]
    edgeSubset = [e for e,edge in enumerate(EV) if all([v in vertexSubset  for v in edge])]
    faceSubset = [f for f,face in enumerate(FV) if all([v in vertexSubset  for v in face])]
    return vertexSubset,faceSubset,edgeSubset

if __name__=="__main__":
    selectBox = ((0.45, 0.45), (0.65, 0.75))
    vertexSubset,faceSubset,edgeSubset = subComplexInBox(V,FV,EV,selectBox)
    #VIEW(EXPLODE(1.2,1.2,1.2)(MKPOLS((V,[EV[e] for e in edgeSubset])) + [
        #COLOR(RED)(MK(selectBox[0])),  COLOR(RED)(MK(selectBox[1]))]))
    #VIEW(EXPLODE(1.2,1.2,1.2)(MKPOLS((V,[FV[f] for f in faceSubset])) + [
        #COLOR(RED)(MK(selectBox[0])),  COLOR(RED)(MK(selectBox[1]))]))
◇
```

Macro referenced in 5a.

Emulation of "pick" input over a LAR normalized representation The function accepts as input the LAR model `V,FV,EV`, the incidence relation `FE`, that provides for each face the list of incident edges, and a `queryPoint` given in normalized coordinates. It returns `vertexSubset` ⊆ `V`, `faceSubset` ⊆ `FV`, `edgeSubset` ⊆ `EV`.

⟨Emulation of "pick" input 3a⟩ ≡

```
""" Emulation of  ''pick'' input over a LAR normalized representation """
def subComplexAroundPoint(V,FV,EV,FE,queryPoint):
    tree = spatial.cKDTree(V)
    pts = np.array([queryPoint])
    dist,closestVertex = tree.query(pts)
    VF = invertRelation(FV)
    closestFaces = VF[closestVertex]

    for face in closestFaces:
        faceEdges = [EV[e] for e in FE[face]]
        classify = pointInPolygonClassification((V,faceEdges))
        if classify(queryPoint) == "p_in":
            break
    vertexSubset = FV[face]
    edgeSubset = [EV[e] for e in FE[face]]
    faceSubset = [face]
    return vertexSubset,faceSubset,edgeSubset

if __name__=="__main__":
    FE = crossRelation(FV,EV)
    queryPoint = (0.6,0.58)
    vertexSubset,faceSubset,edgeSubset = subComplexAroundPoint(V,FV,EV,FE,queryPoint)
    ##VIEW(EXPLODE(1.2,1.2,1.2)(MKPOLS((V,[EV[e] for e in FE[faceSubset[0]]])) + [
        #COLOR(RED)(MK(queryPoint))] ))
◇
```

Macro referenced in 5a.

From LAR chain to colored HPCs The function `cells2hpcs` is used to assign a given `k` color to the cells of a chain (cell subset) of a LAR model `V,FV`. The function returns a list of HPC (colored) objects.

⟨From LAR chain to colored HPCs 3b⟩ ≡

```
""" From LAR chain to colored HPCs """
def cells2hpcs(V,FV,cells,k):
    colors = [RED,GREEN,BLUE,CYAN,MAGENTA,YELLOW,WHITE,PURPLE,BROWN]
    return AA(COLOR(colors[k]))(MKPOLS((V,[FV[f] for f in cells])))
```

◇

Macro referenced in 5a.

2.3 Structural operations

From 2D chains to boundary chains

⟨From 2D chains to boundary chains 4a⟩ ≡

```
""" From 2D chains to boundary chains """
def chain2BoundaryChain(csrBoundaryMat):
   nedges,nfaces = csrBoundaryMat.shape
   def chain2BoundaryChain0(chain):
      row = np.array(range(len(chain)))
      col = np.array([0 for k in range(len(chain))])
      data = np.array(chain)
      csrFaceVect = scipy.sparse.coo_matrix((data, (row, col)), shape=(nfaces,1)).tocsr()
      csrEdgeVect = csrBoundaryMat*csrFaceVect
      boundaryChain = [h for h,val in
         zip(csrEdgeVect.tocoo().row, csrEdgeVect.tocoo().data) if val%2 != 0]
      return boundaryChain
   return chain2BoundaryChain0
```

◇

Macro referenced in 5a.

From chains to structures

⟨From chains to structures 4b⟩ ≡

```
""" From chains to structures """
def chain2structs(V,FV,EV,FE):
    def chain2structs0(args):
        if args == ([],[],[]): return
        chain,chainName,classtype = args
        struct = []
        for cell in chain:
```

```
            vs = [V[v] for v in FV[cell]]
            vdict = dict([[vcode(vert),k] for k,vert in enumerate(vs)])
            facetEdges = [[V[v] for v in EV[e]] for e in FE[cell]]
            ev = [(vdict[vcode(v1)], vdict[vcode(v2)]) for v1,v2 in facetEdges]
            fv = [range(len(vs))]
            shape = vs,fv,ev
            struct += [ Struct([ shape ], name=None, category="room" ) ]
        out = Struct( struct, name=chainName, category=classtype )
        return out
    return chain2structs0
◇
```

Macro referenced in 5a.

3 Exporting the library

"larlib/larlib/hijson.py" 5a ≡

```
""" Module for Structured input to HIJSON """
from larlib import *
from copy import copy
DEBUG = False
```

⟨SVG file input and computation of cellular complex 2a⟩
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◇

4 Test examples

4.1 Example of a complex building model: part definition

Visualization of cell numbering in a 2D complex

⟨Visualization of cell numbering in a 2D complex 5b⟩ ≡

```
""" Visualization of cell numbering in a 2D complex """
VV = AA(LIST)(range(len(V)))
submodel = STRUCT(MKPOLS((V,EV)))
#VIEW(larModelNumbering(1,1,1)(V,[VV,EV,FV[:-1]],submodel,2.5))
◇
```

Macro referenced in 11a.

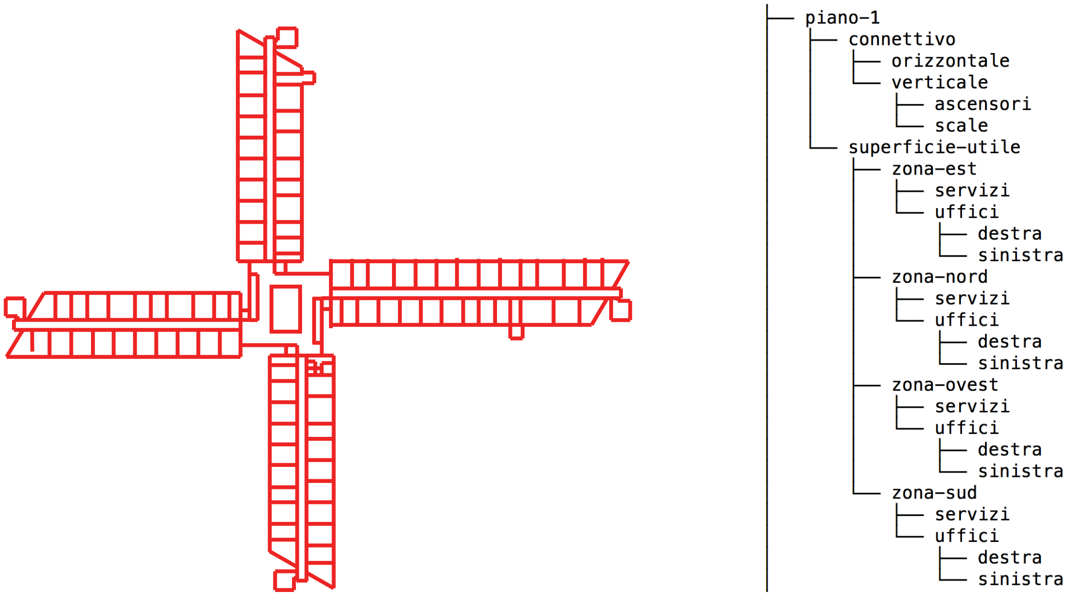

Figure 1: The input SVG drawing of the typical floor layout.

Ala nord (HPCs)

⟨ Ala nord 6a ⟩ ≡

```
FE = crossRelation(FV,EV)
chainsToStruct = chain2structs(V,FV,EV,FE)

""" Ala nord """
boxes = [0 for k in range(64)]
point = [0 for k in range(64)]
boxes[0] = array([[0.431, 0.607], [0.474, 0.91]])*scaleFactor #[V[k] for k in [39,208]]
boxes[1] = array([[0.416, 0.657], [0.372, 0.953]])*scaleFactor #[V[k] for k in [162,39]]
boxes[2] = array([[0.416, 0.627], [0.431, 0.986]])*scaleFactor #[V[k] for k in [206,247]]
boxes[3] = array([[0.431, 0.607], [0.448, 0.627]])*scaleFactor #[V[k] for k in [39,7]]
boxes[4] = array([[0.431, 0.91], [0.494, 0.929]])*scaleFactor  #[V[k] for k in [213,234]]
boxes[5] = array([[0.431, 0.97], [0.466, 1.0]])*scaleFactor #[V[k] for k in [58,88]]
boxes[27] = array([[0.416, 0.627], [0.372, 0.657]])*scaleFactor #[V[k] for k in [110,82]]

point[0] = array([0.394, 0.9625])*scaleFactor #CCOMB([V[k] for k in [190,197]])
point[1] = array([0.4525, 0.9325])*scaleFactor #CCOMB([V[k] for k in [166,159]])

piano1_superficieUtile_zonaNord_uffici_destra = subComplexInBox(V,FV,EV,boxes[0])[1]
piano1_superficieUtile_zonaNord_uffici_sinistra = subComplexInBox(V,FV,EV,boxes[1])[1]
piano1_connettivo_orizzontale_zonaNord = subComplexInBox(V,FV,EV,boxes[2])[1]
piano1_connettivo_verticale_zonaNord_ascensore = subComplexInBox(V,FV,EV,boxes[3])[1]
```

```
piano1_connettivo_verticale_zonaNord_ascensore += subComplexInBox(V,FV,EV,boxes[4])[1]
piano1_connettivo_verticale_zonaNord_scale = subComplexInBox(V,FV,EV,boxes[5])[1]
piano1_superficieUtile_zonaNord_servizi = subComplexAroundPoint(V,FV,EV,FE,point[0])[1]
piano1_superficieUtile_zonaNord_servizi += subComplexAroundPoint(V,FV,EV,FE,point[1])[1]
piano1_superficieUtile_zonaNord_servizi += subComplexInBox(V,FV,EV,boxes[27])[1]

piano1N = [piano1_superficieUtile_zonaNord_uffici_destra, piano1_superficieUtile_zonaNord_uffic
◇
```

Macro defined by 6ab.
Macro referenced in 11a.

⟨ Ala nord 6b ⟩ ≡

```
""" Ala nord """
piano1N_nomi = ["piano1_superficieUtile_zonaNord_uffici_destra", "piano1_superficieUtile_zonaNo
piano1N_categorie = ["uffici","uffici","corridoi","ascensori","scale","servizi"]
p1N = zip(piano1N,piano1N_nomi,piano1N_categorie)
piano1_zonaNord = Struct(AA(chainsToStruct)(p1N),"piano1_zonaNord","ala")
#VIEW(SKEL_1(STRUCT(MKPOLS(struct2lar(piano1_zonaNord)))))

nord = CAT([cells2hpcs(V,FV,chain,k) for k,chain in enumerate(piano1N)])
#VIEW(EXPLODE(1.2,1.2,1.2)(nord))
◇
```

Macro defined by 6ab.
Macro referenced in 11a.

Ala est (HPCs)

⟨ Ala est 7a ⟩ ≡

```
""" Ala est """
boxes[6] = array([[0.019, 0.533], [0.376, 0.577]])*scaleFactor #[V[k] for k in [241,29]]
boxes[7] = array([[0.07, 0.474], [0.343, 0.518]])*scaleFactor #[V[k] for k in [264,148]]
boxes[8] = array([[0.013, 0.518], [0.376, 0.533]])*scaleFactor #[V[k] for k in [22,63]]
boxes[9] = array([[0.376, 0.533], [0.39, 0.549]])*scaleFactor #[V[k] for k in [63,92]]
boxes[10] = array([[0.001, 0.474], [0.07, 0.518]])*scaleFactor #[V[k] for k in [263,265]]
boxes[11] = array([[0.343, 0.474], [0.376, 0.518]])*scaleFactor #[V[k] for k in [84,149]]

point[2] = array([0.015, 0.5535])*scaleFactor #CCOMB([V[k] for k in [228,14]])

piano1_superficieUtile_zonaEst_uffici_destra = subComplexInBox(V,FV,EV,boxes[6])[1]
piano1_superficieUtile_zonaEst_uffici_sinistra = subComplexInBox(V,FV,EV,boxes[7])[1]
piano1_connettivo_orizzontale_zonaEst = subComplexInBox(V,FV,EV,boxes[8])[1]
piano1_connettivo_verticale_zonaEst_ascensore = subComplexInBox(V,FV,EV,boxes[9])[1]
piano1_connettivo_verticale_zonaEst_scale = subComplexAroundPoint(V,FV,EV,FE,point[2])[1]
piano1_superficieUtile_zonaEst_servizi = subComplexInBox(V,FV,EV,boxes[10])[1]
piano1_superficieUtile_zonaEst_servizi += subComplexInBox(V,FV,EV,boxes[11])[1]
```

```
piano1E = [piano1_superficieUtile_zonaEst_uffici_destra, piano1_superficieUtile_zonaEst_uffici_
◇
```

Macro defined by 7ab.
Macro referenced in 11a.

⟨ Ala est 7b ⟩ ≡

```
""" Ala est """
piano1E_nomi = ["piano1_superficieUtile_zonaEst_uffici_destra", "piano1_superficieUtile_zonaEst
piano1E_categorie = ["uffici","uffici","corridoi","ascensori","scale","servizi"]
p1E = zip(piano1E,piano1E_nomi, piano1E_categorie)
piano1_zonaEst = Struct(AA(chainsToStruct)(p1E), "piano1_zonaEst", "ala")
#VIEW(SKEL_1(STRUCT(MKPOLS(struct2lar(piano1_zonaEst)))))

est = CAT([cells2hpcs(V,FV,chain,k) for k,chain in enumerate(piano1E)])
#VIEW(EXPLODE(1.2,1.2,1.2)(est + nord))
◇
```

Macro defined by 7ab.
Macro referenced in 11a.

Ala sud (HPCs)

⟨ Ala sud 8a ⟩ ≡

```
""" Ala sud """
boxes[12] = array([[0.467, 0.138], [0.423, 0.476]])*scaleFactor #[V[k] for k in [252,47]]
boxes[13] = array([[0.482, 0.145], [0.525, 0.445]])*scaleFactor #[V[k] for k in [241,126]]
boxes[14] = array([[0.482, 0.476], [0.467, 0.116]])*scaleFactor #[V[k] for k in [254,232]]
boxes[15] = array([[0.449, 0.476], [0.467, 0.493]])*scaleFactor #[V[k] for k in [40,237]]
boxes[16] = array([[0.431, 0.101], [0.467, 0.131]])*scaleFactor #[V[k] for k in [259,2]]
boxes[17] = array([[0.482, 0.445], [0.525, 0.476]])*scaleFactor #[V[k] for k in [155,248]]
boxes[18] = array([[0.525, 0.104], [0.482, 0.145]])*scaleFactor #[V[k] for k in [111,241]]

piano1_superficieUtile_zonaSud_uffici_destra = subComplexInBox(V,FV,EV,boxes[12])[1]
piano1_superficieUtile_zonaSud_uffici_sinistra = subComplexInBox(V,FV,EV,boxes[13])[1]
piano1_connettivo_orizzontale_zonaSud = subComplexInBox(V,FV,EV,boxes[14])[1]
piano1_connettivo_verticale_zonaSud_ascensore = subComplexInBox(V,FV,EV,boxes[15])[1]
piano1_connettivo_verticale_zonaSud_scale = subComplexInBox(V,FV,EV,boxes[16])[1]
piano1_superficieUtile_zonaSud_servizi = subComplexInBox(V,FV,EV,boxes[17])[1]
piano1_superficieUtile_zonaSud_servizi += subComplexInBox(V,FV,EV,boxes[18])[1]

piano1S = [piano1_superficieUtile_zonaSud_uffici_destra, piano1_superficieUtile_zonaSud_uffici_
◇
```

Macro defined by 8ab.
Macro referenced in 11a.

⟨ Ala sud 8b ⟩ ≡

```
""" Ala sud """
piano1S_nomi = ["piano1_superficieUtile_zonaSud_uffici_destra", "piano1_superficieUtile_zonaSud
piano1S_categorie = ["uffici","uffici","corridoi","ascensori","scale","servizi"]
p1S = zip(piano1S,piano1S_nomi, piano1S_categorie)
piano1_zonaSud = Struct(AA(chainsToStruct)(p1S), "piano1_zonaSud", "ala")
#VIEW(SKEL_1(STRUCT(MKPOLS(struct2lar(piano1_zonaSud)))))

sud = CAT([cells2hpcs(V,FV,chain,k) for k,chain in enumerate(piano1S)])
#VIEW(EXPLODE(1.2,1.2,1.2)(est + nord + sud))
◇
```

Macro defined by 8ab.
Macro referenced in 11a.

Ala ovest (HPCs)

⟨ Ala ovest 8c ⟩ ≡

```
""" Ala ovest """
boxes[19] = array([[0.521, 0.526], [0.963, 0.568]])*scaleFactor #[V[k] for k in [169,202]]
boxes[20] = array([[0.555, 0.584], [0.955, 0.627]])*scaleFactor #[V[k] for k in [12,23]]
boxes[21] = array([[0.521, 0.568], [0.985, 0.584]])*scaleFactor #[V[k] for k in [209,204]]
boxes[22] = array([[0.506, 0.551], [0.521, 0.568]])*scaleFactor #[V[k] for k in [89,209]]
boxes[23] = array([[0.808, 0.504], [0.828, 0.526]])*scaleFactor #[V[k] for k in [270,77]]
boxes[24] = array([[0.955, 0.584], [0.997, 0.627]])*scaleFactor #[V[k] for k in [220,24]]
boxes[25] = array([[0.521, 0.584], [0.555, 0.627]])*scaleFactor #[V[k] for k in [11,144]]
boxes[26] = array([[1.0, 0.533], [0.97, 0.568]])*scaleFactor #[V[k] for k in [233,201]]

piano1_superficieUtile_zonaOvest_uffici_destra = subComplexInBox(V,FV,EV,boxes[19])[1]
piano1_superficieUtile_zonaOvest_uffici_sinistra = subComplexInBox(V,FV,EV,boxes[20])[1]
piano1_connettivo_orizzontale_zonaOvest = subComplexInBox(V,FV,EV,boxes[21])[1]
piano1_connettivo_verticale_zonaOvest_ascensore = subComplexInBox(V,FV,EV,boxes[22])[1]
piano1_connettivo_verticale_zonaOvest_ascensore += subComplexInBox(V,FV,EV,boxes[23])[1]
piano1_superficieUtile_zonaOvest_servizi = subComplexInBox(V,FV,EV,boxes[24])[1]
piano1_superficieUtile_zonaOvest_servizi += subComplexInBox(V,FV,EV,boxes[25])[1]
piano1_connettivo_verticale_zonaOvest_scale = subComplexInBox(V,FV,EV,boxes[26])[1]

piano1O = [piano1_superficieUtile_zonaOvest_uffici_destra, piano1_superficieUtile_zonaOvest_uff
◇
```

Macro defined by 8c, 9a.
Macro referenced in 11a.

⟨ Ala ovest 9a ⟩ ≡

```
""" Ala ovest """
piano1O_nomi = ["piano1_superficieUtile_zonaOvest_uffici_destra", "piano1_superficieUtile_zonaO
piano1O_categorie = ["uffici","uffici","corridoi","ascensori","scale","servizi"]
p1O = zip(piano1O,piano1O_nomi, piano1O_categorie)
piano1_zonaOvest = Struct(AA(chainsToStruct)(p1O), "piano1_zonaOvest", "ala")
```

```
#VIEW(SKEL_1(STRUCT(MKPOLS(struct2lar(piano1_zonaOvest)))))

ovest = CAT([cells2hpcs(V,FV,chain,k) for k,chain in enumerate(piano1O)])
#VIEW(EXPLODE(1.2,1.2,1.2)(est + nord + sud + ovest))
◇
```

Macro defined by 8c, 9a.
Macro referenced in 11a.

Centro stella (HPCs)

⟨ Centro stella 9b ⟩ ≡

```
""" Centro stella """
piano1_connettivo_orizzontale_centroStella = [2]
piano1_connettivo_verticale_centroStella_scale = [15,26]

piano1C = [[],[],piano1_connettivo_orizzontale_centroStella,[], piano1_connettivo_verticale_cen
centro = CAT([cells2hpcs(V,FV,chain,k) for k,chain in enumerate(piano1C)])
◇
```

Macro defined by 9b, 10a.
Macro referenced in 11a.

⟨ Centro stella 10a ⟩ ≡

```
""" Centro stella """
piano1C_nomi = [[],[],"piano1_connettivo_orizzontale_centroStella", [], "piano1_connettivo_vert
piano1C_categorie = [[],[],"corridoi",[], "ascensori"]
p1C = zip(piano1C,piano1C_nomi, piano1C_categorie)
piano1_centroStella = Struct(AA(chainsToStruct)(p1C), "piano1_centroStella", "centro")
#VIEW(SKEL_1(STRUCT(MKPOLS(struct2lar(piano1_centroStella)))))

#VIEW(EXPLODE(1.2,1.2,1.2)(est + nord + sud + ovest + centro))
#VIEW(STRUCT(est + nord + sud + ovest + centro))
◇
```

Macro defined by 9b, 10a.
Macro referenced in 11a.

4.2 Example of a complex building model: integration

Assembly of parts (HPCs)

⟨ Assemblaggio 10b ⟩ ≡

```
""" Assemblaggio """
p1 = p1N + p1S + p1E + p1O + p1C

piano1_nomi = ["piano1_zonaNord", "piano1_zonaEst", "piano1_zonaSud", "piano1_zonaOvest", "pian
piano1_categorie = ["ala","ala","ala","ala","centro"]
piano1 = Struct(AA(chainsToStruct)(p1), "piano1", "level")
```

```
#VIEW(SKEL_1(STRUCT(MKPOLS(struct2lar(piano1)))))

V,boundaryEdges = structBoundaryModel(piano1)
drawing = mkSignedEdges((V,boundaryEdges))
#VIEW(drawing)

polylines = boundaryModel2polylines((V,boundaryEdges))
#VIEW(STRUCT(AA(POLYLINE)(polylines)))

print boundaryPolylines(piano1)
◇
```

Macro referenced in 11a.

Assembling floor layout generation

⟨ Assembling floor layout generation 11a ⟩ ≡

```
""" Assembling floor layout generation """
⟨Visualization of cell numbering in a 2D complex 5b⟩
⟨Ala nord 6a, ... ⟩
⟨Ala est 7a, ... ⟩
⟨Ala sud 8a, ... ⟩
⟨Ala ovest 8c, ... ⟩
⟨Centro stella 9b, ... ⟩
⟨Assemblaggio 10b⟩
◇
```

Macro referenced in 11c, 12.

⟨ Tower example initialization 11b ⟩ ≡

```
""" make the model of a layout floor """

scaleFactor = 83.333

filename = "test/svg/inters/plan.svg"
larModel = svg2lar(filename)
larModel = larApply(s(scaleFactor,scaleFactor))(larModel)
V,FV,EV = larModel
FV[2] += FV[71]      # for now :o)
◇
```

Macro referenced in 11c, 12.

"test/py/hijson/test01.py" 11c ≡

```
""" make the model of a layout floor """
from larlib import *
```

```
⟨Tower example initialization 11b⟩
⟨Assembling floor layout generation 11a⟩

primoPiano = AA(list)([CAT(AA(S1)(p1N)),CAT(AA(S1)(p1E)),CAT(AA(S1)(p1S)),
                CAT(AA(S1)(p1O)),CAT(AA(S1)(p1C))])
primoPiano_nomi = ["piano1_zonaNord","piano1_zonaEst","piano1_zonaSud","piano1_zonaOvest","pia
primoPiano_categorie = ["ala","ala","ala","ala","centro"]
pianoPrimo = zip(primoPiano, primoPiano_nomi, primoPiano_categorie)
piano_1 = Struct( AA(chainsToStruct)(pianoPrimo), "piano1", "level" )

piano_1_3D = embedStruct(1)(piano_1,"3D")
iot3d.printStruct2GeoJson("./",piano_1_3D)

print "piano_1_3D =",piano_1_3D.category
print "piano_1_3D.body[0] =",piano_1_3D.body[0].category
print "piano_1_3D.body[0].body[0] =",piano_1_3D.body[0].body[0].category
◇
```

"test/py/hijson/test02.py" 12 ≡

```
""" make the 2.5 model of a building tower """
from larlib import *

⟨Tower example initialization 11b⟩
⟨Assembling floor layout generation 11a⟩

pianoNord3D = embedStruct(1)(piano1_zonaNord,"3D")
pianoEst3D = embedStruct(1)(piano1_zonaEst,"3D")
pianoSud3D = embedStruct(1)(piano1_zonaSud,"3D")
pianoOvest3D = embedStruct(1)(piano1_zonaOvest,"3D")
pianoCentro3D = embedStruct(1)(piano1_centroStella,"3D")
torreNord = Struct(4*[pianoNord3D,t(0,0,3)], "torreNord", "edificio")
torreEst = Struct(7*[pianoEst3D,t(0,0,3)], "torreEst", "edificio")
torreSud = Struct(7*[pianoSud3D,t(0,0,3)], "torreSud", "edificio")
torreOvest = Struct(7*[pianoOvest3D,t(0,0,3)], "torreOvest", "edificio")
torreCentro = Struct(7*[pianoCentro3D,t(0,0,3)], "torreCentro", "edificio")
torre = Struct([torreNord,torreEst,torreSud,torreOvest,torreCentro],"torre", "edificio")
V,FV,EV = struct2lar(torre)
#VIEW(EXPLODE(1.2,1.2,1.2)(MKPOLS((V,EV))))
#VIEW(STRUCT(MKPOLS((V,FV))))
◇
```

References

[CL13] CVD-Lab, *Linear algebraic representation*, Tech. Report 13-00, Roma Tre University, October 2013.

[DPS14] Antonio Dicarlo, Alberto Paoluzzi, and Vadim Shapiro, *Linear algebraic representation for topological structures*, Comput. Aided Des. **46** (2014), 269–274.

[PDFJ15] Alberto Paoluzzi, Antonio DiCarlo, Francesco Furiani, and Miroslav Jirik, *Cad models from medical images using lar*, Computer-Aided Design and Applications **13** (2015), To appear.