```
  Activating project at `~/.julia/environments/v1.8`
```

Метод "кривых" сеток для Пуассона

$$\frac{\partial^2 u(x,y)}{\partial x^2} + \frac{\partial^2 u(x,y)}{\partial y^2} = 1.91$$

$$x^2 + y^2 = 1$$

$$u_\Gamma(x,y) = 0.7x^2 + 0.3y^2 + 0.6$$

```
h = 0.2
```

```
h = 0.2
```

```
UΓ (generic function with 1 method)
```

```
UΓ((x, y)) = 0.7*x^2 + 0.3*y^2 + 0.6
```

Область значения функции

```
(-1.0:0.2:1.0, -1.0:0.2:1.0)
```

```
begin
    X = -1:h:1
    Y = -1:h:1

    X, Y
end
```

```
Γ = 11×11 Matrix{Union{Missing, Tuple{Float64, Float64}}}:
 missing      missing       missing       …  missing      missing      missing
 missing      missing       (-0.8, -0.6)     (-0.8, 0.6)  missing      missing
 missing      (-0.6, -0.8)  (-0.6, -0.6)     (-0.6, 0.6)  (-0.6, 0.8)  missing
 missing      (-0.4, -0.8)  (-0.4, -0.6)     (-0.4, 0.6)  (-0.4, 0.8)  missing
 missing      (-0.2, -0.8)  (-0.2, -0.6)     (-0.2, 0.6)  (-0.2, 0.8)  missing
 (0.0, -1.0)  (0.0, -0.8)   (0.0, -0.6)   …  (0.0, 0.6)   (0.0, 0.8)   (0.0, 1.0)
 missing      (0.2, -0.8)   (0.2, -0.6)      (0.2, 0.6)   (0.2, 0.8)   missing
 missing      (0.4, -0.8)   (0.4, -0.6)      (0.4, 0.6)   (0.4, 0.8)   missing
 missing      (0.6, -0.8)   (0.6, -0.6)      (0.6, 0.6)   (0.6, 0.8)   missing
 missing      missing       (0.8, -0.6)      (0.8, 0.6)   missing      missing
 missing      missing       missing       …  missing      missing      missing
```

```
Γ = [
    x^2 + y^2 ≤ 1 ? (x, y) : missing
    for x in X, y in Y
]
```

```
Γ_ind =
```

```
[CartesianIndex(6, 1), CartesianIndex(3, 2), CartesianIndex(4, 2), CartesianIndex(5, 2), (
```

```
Γ_ind = collect(CartesianIndices(Γ))[.!ismissing.(Γ)]
```

```
11×11 Matrix{Union{Missing, Tuple{Float64, Float64}}}:
 missing      missing       missing       …  missing      missing      missing
 missing      missing       (-0.8, -0.6)     (-0.8, 0.6)  missing      missing
 missing      (-0.6, -0.8)  missing          missing      (-0.6, 0.8)  missing
 missing      (-0.4, -0.8)  missing          missing      (-0.4, 0.8)  missing
 missing      missing       missing          missing      missing      missing
 (0.0, -1.0)  missing       missing       …  missing      missing      (0.0, 1.0)
 missing      missing       missing          missing      missing      missing
 missing      (0.4, -0.8)   missing          missing      (0.4, 0.8)   missing
 missing      (0.6, -0.8)   missing          missing      (0.6, 0.8)   missing
 missing      missing       (0.8, -0.6)      (0.8, 0.6)   missing      missing
 missing      missing       missing       …  missing      missing      missing
```

```
begin
    B = [
        isapprox(x^2 + y^2, 1; atol=0.2) ? (x, y) : missing
        for x in X, y in Y
    ]

    B_ind = collect(CartesianIndices(B))[.!ismissing.(Γ) .&& .!ismissing.(B)]
    B[.!(.!ismissing.(Γ) .&& .!ismissing.(B))] .= missing
    B
end
```

Индексы точек внутренней области

```
[CartesianIndex(6, 1), CartesianIndex(3, 2), CartesianIndex(4, 2), CartesianIndex(8, 2), (
```

```
B_ind
```

```
I_ind =
 [CartesianIndex(5, 2), CartesianIndex(6, 2), CartesianIndex(7, 2), CartesianIndex(3, 3), (
```

```
I_ind = Γ_ind[.!(Γ_ind .∈ (B_ind,))]
```

```
true
```

```
isdisjoint(B_ind, I_ind)
```

Решение

```
11×11 Matrix{Float64}:
 Inf   Inf     Inf     Inf     Inf   1.3  Inf  Inf     Inf     Inf     Inf
 Inf   Inf      1.156   1.096  Inf   Inf   Inf   1.096   1.156  Inf     Inf
 Inf    1.044  Inf     Inf     Inf   Inf   Inf  Inf     Inf      1.044  Inf
 Inf    0.904  Inf     Inf     Inf   Inf   Inf  Inf     Inf      0.904  Inf
 Inf   Inf     Inf     Inf     Inf   Inf   Inf  Inf     Inf     Inf     Inf
  0.9  Inf     Inf     Inf     Inf   Inf   Inf  Inf     Inf     Inf      0.9
 Inf   Inf     Inf     Inf     Inf   Inf   Inf  Inf     Inf     Inf     Inf
 Inf    0.904  Inf     Inf     Inf   Inf   Inf  Inf     Inf      0.904  Inf
 Inf    1.044  Inf     Inf     Inf   Inf   Inf  Inf     Inf      1.044  Inf
 Inf   Inf      1.156   1.096  Inf   Inf   Inf   1.096   1.156  Inf     Inf
 Inf   Inf     Inf     Inf     Inf   1.3  Inf  Inf     Inf     Inf     Inf
```

```
begin
    U = fill(Inf, size(Γ))
    U[B_ind] = UΓ.(B[B_ind])

    U
end
```

```
view(::Matrix{Float64}, CartesianIndex{2}[CartesianIndex(5, 2), CartesianIndex(6, 2), Car
```

```
U[I_ind] .= 0
```

```
11×11 Matrix{Float64}:
 Inf   Inf     Inf     Inf     Inf   1.3  Inf   Inf     Inf     Inf     Inf
 Inf   Inf      1.156   1.096   0.0  0.0   0.0   1.096   1.156  Inf     Inf
 Inf    1.044   0.0     0.0     0.0  0.0   0.0   0.0     0.0     1.044  Inf
 Inf    0.904   0.0     0.0     0.0  0.0   0.0   0.0     0.0     0.904  Inf
 Inf    0.0     0.0     0.0     0.0  0.0   0.0   0.0     0.0     0.0    Inf
  0.9   0.0     0.0     0.0     0.0  0.0   0.0   0.0     0.0     0.0     0.9
 Inf    0.0     0.0     0.0     0.0  0.0   0.0   0.0     0.0     0.0    Inf
 Inf    0.904   0.0     0.0     0.0  0.0   0.0   0.0     0.0     0.904  Inf
 Inf    1.044   0.0     0.0     0.0  0.0   0.0   0.0     0.0     1.044  Inf
 Inf   Inf      1.156   1.096   0.0  0.0   0.0   1.096   1.156  Inf     Inf
 Inf   Inf     Inf     Inf     Inf   1.3  Inf   Inf     Inf     Inf     Inf
```

```
U
```

```
 [CartesianIndex(5, 2), CartesianIndex(6, 2), CartesianIndex(7, 2), CartesianIndex(3, 3), (
```

```
collect(CartesianIndices(U))[I_ind]
```

```
Dict(CartesianIndex(8, 4) => [35, 40, 41, 42, 47], CartesianIndex(4, 7) => [64, 69, 70, 71
```

```
begin
    M = hcat([
        (collect(LinearIndices(U)).-6)[I_ind],
        (collect(LinearIndices(U)).-1)[I_ind],
        collect(LinearIndices(U))[I_ind],
        (collect(LinearIndices(U)).+1)[I_ind],
        (collect(LinearIndices(U)).+6)[I_ind]
    ]...)

    mapping = Dict(
        collect(CartesianIndices(U))[I_ind] .=> [
        M[i, :]
        for i in 1:size(M, 1)
    ])
end
```

Φ =

```
[0.0764, 0.0764, 0.0764, 0.0764, 0.0764, 0.0764, 0.0764, 0.0764, 0.0764, 0.0764, 0.0764, 0.
```

```
Φ = fill(1.91 * h^2, 121)
```

```
121×121 Matrix{Float64}:
 0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  …  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
 0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0     0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
 0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0     0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
 0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0     0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
 0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0     0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
 0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  …  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
 0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0     0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
 ⋮                        ⋮              ⋱              ⋮                        ⋮
 0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  …  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
 0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0     0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
 0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0     0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
 0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0     0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
 0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0     0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
 0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0  …  0.0  0.0  0.0  0.0  0.0  0.0  0.0  0.0
```

```
begin
    A = zeros(121, 121)

    for ind in I_ind
        A[mapping[ind][3], mapping[ind]] = [1, 1, -4, 1, 1]
    end

    A
end
```

S_ind =

```
[10, 11, 12, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31,    more ,10
```

```
# индексы точек, где будем решать систему
S_ind = unique(sort(vcat(last.(collect(mapping))...)))
```

```
[0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.00639184, 0.00790038, 0.00472398, 0.0, 0.0,
```

```
begin
    u = zeros(11, 11)
    u[1:121] = A[S_ind, :] \ Φ[S_ind]
end
```

```
[-0.017667, -0.0204857, -0.0109956, -0.0174773, -0.0175655, -0.0197655, -0.0118037, -0.005
```

```
U[I_ind] = u[I_ind]
```

	X=-0.2	X=0.0	X=0.2	X=0.4	X=0.6	X=0.8	X=1.0
1	Inf	1.3	Inf	Inf	Inf	Inf	Inf
2	-0.0272493	-0.0245065	-0.0273693	1.096	1.156	Inf	Inf
3	-0.0622965	-0.0768238	-0.0739077	-0.0242773	-0.0241233	1.044	Inf
4	-0.0442	-0.0639858	-0.0655791	-0.0274289	-0.0222745	0.904	Inf
5	0.0135432	-0.0043052	-0.00793564	-0.0207651	-0.00530893	-0.0109956	Inf
6	0.0186995	0.0234151	0.0186995	0.00719243	-0.0118037	-0.0204857	0.9
7	-0.00793564	-0.0043052	0.0135432	-0.00776942	-0.0197655	-0.017667	Inf
8	-0.0655791	-0.0639858	-0.0442	-0.0143432	-0.0175655	0.904	Inf
9	-0.0739077	-0.0768238	-0.0622965	-0.015818	-0.0174773	1.044	Inf
10	-0.0273693	-0.0245065	-0.0272493	1.096	1.156	Inf	Inf
11	Inf	1.3	Inf	Inf	Inf	Inf	Inf

```
DataFrame(
    [Y U],
    ["Y"; "X=".*string.(X)]
)
```