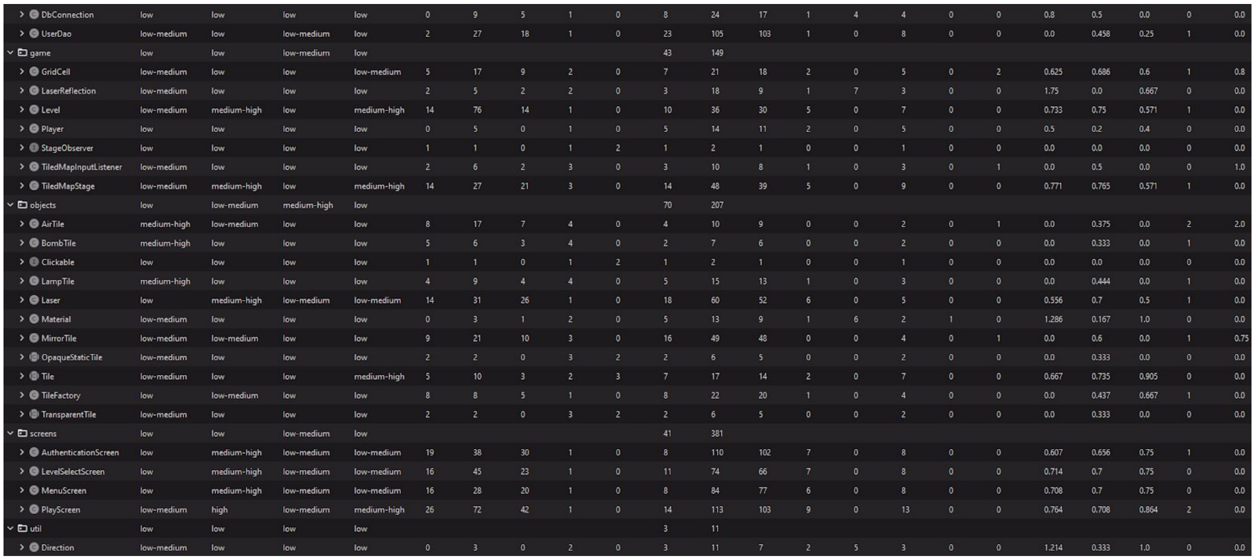
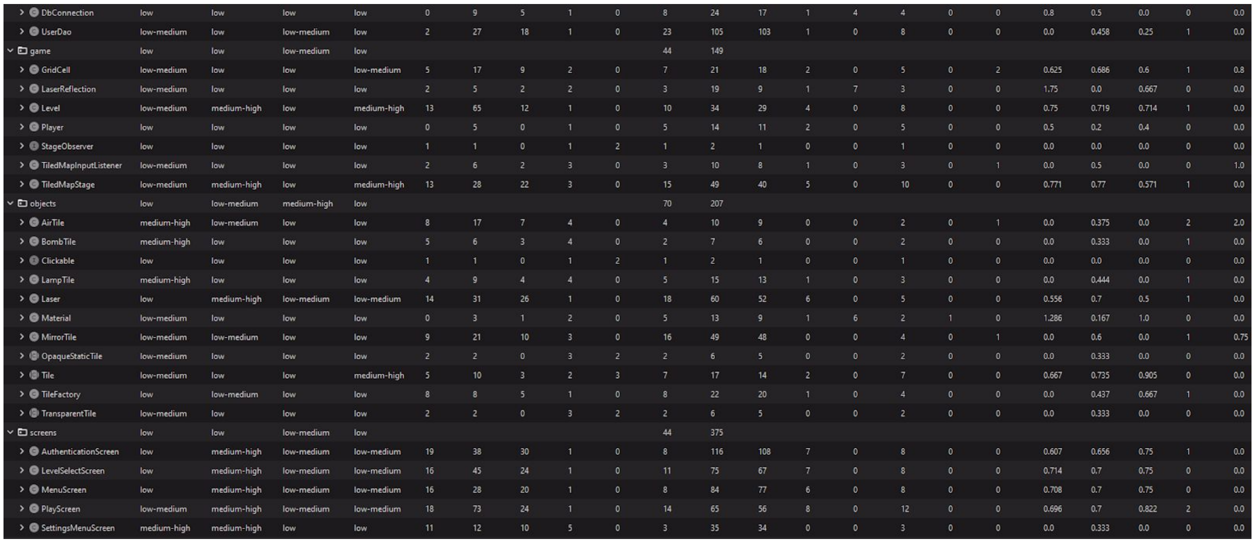
Assignment 4

Before



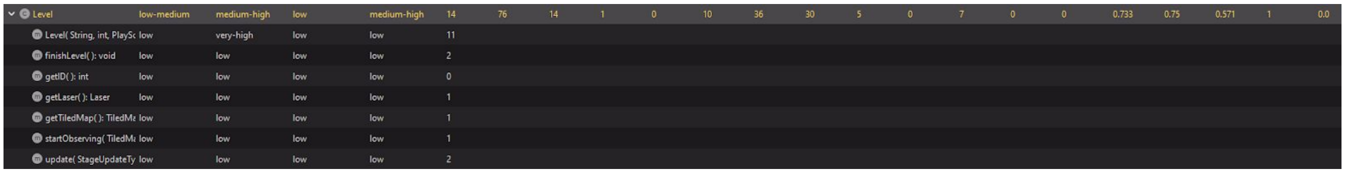
DbConnection	low	low	low	low	0	9	5	1	0	8	24	17	1	4	4	0	0	0.8	0.5	0.0	0	0.0
UserDao	low-medium	low	low-medium	low	2	27	18	1	0	23	105	103	1	0	8	0	0	0.0	0.458	0.25	1	0.0
game	low	low	low-medium	low						43	149											
GridCell	low-medium	low	low	low-medium	5	17	9	2	0	7	21	18	2	0	5	0	2	0.625	0.686	0.6	1	0.8
LaserReflection	low-medium	low	low	low	2	5	2	2	0	3	18	9	1	7	3	0	0	1.75	0.0	0.667	0	0.0
Level	low-medium	medium-high	low	medium-high	14	76	14	1	0	10	36	30	5	0	7	0	0	0.733	0.75	0.571	1	0.0
Player	low	low	low	low	0	5	0	1	0	5	14	11	2	0	5	0	0	0.5	0.2	0.4	0	0.0
StageObserver	low	low	low	low	1	1	0	1	2	1	2	1	0	0	1	0	0	0.0	0.0	0.0	0	0.0
TiledMapInputListener	low-medium	low	low	low	2	6	2	3	0	3	10	8	1	0	3	0	1	0.0	0.5	0.0	0	1.0
TiledMapStage	low-medium	medium-high	low	medium-high	14	27	21	3	0	14	48	39	5	0	9	0	0	0.771	0.765	0.571	1	0.0
objects	low	low-medium	medium-high	low						70	207											
AirTile	medium-high	low-medium	low	low	8	17	7	4	0	4	10	9	0	0	2	0	1	0.0	0.375	0.0	2	2.0
BombTile	medium-high	low	low	low	5	6	3	4	0	2	7	6	0	0	2	0	0	0.0	0.333	0.0	1	0.0
Clickable	low	low	low	low	1	1	0	1	2	1	2	1	0	0	1	0	0	0.0	0.0	0.0	0	0.0
LampTile	medium-high	low	low	low	4	9	4	4	0	5	15	13	1	0	3	0	0	0.0	0.444	0.0	1	0.0
Laser	low	medium-high	low-medium	low-medium	14	31	26	1	0	18	60	52	6	0	5	0	0	0.556	0.7	0.5	1	0.0
Material	low-medium	low	low	low	0	3	1	2	0	5	13	9	1	6	2	1	0	1.286	0.167	1.0	0	0.0
MirrorTile	low-medium	low-medium	low	low	9	21	10	3	0	16	49	48	0	0	4	0	1	0.0	0.6	0.0	1	0.75
OpaqueStaticTile	low-medium	low	low	low	2	2	0	3	2	2	6	5	0	0	2	0	0	0.0	0.333	0.0	0	0.0
Tile	low-medium	low	low	medium-high	5	10	3	2	3	7	17	14	2	0	7	0	0	0.667	0.735	0.905	0	0.0
TileFactory	low	low-medium	low	low	8	8	5	1	0	8	22	20	1	0	4	0	0	0.0	0.437	0.667	1	0.0
TransparentTile	low-medium	low	low	low	2	2	0	3	2	2	6	5	0	0	2	0	0	0.0	0.333	0.0	0	0.0
screens	low	low	low-medium	low						41	381											
AuthenticationScreen	low	medium-high	low-medium	low-medium	19	38	30	1	0	8	110	102	7	0	8	0	0	0.607	0.656	0.75	1	0.0
LevelSelectScreen	low	medium-high	low-medium	low-medium	16	45	23	1	0	11	74	66	7	0	8	0	0	0.714	0.7	0.75	0	0.0
MenuScreen	low	medium-high	low-medium	low-medium	16	28	20	1	0	8	84	77	6	0	8	0	0	0.708	0.7	0.75	0	0.0
PlayScreen	low-medium	high	low-medium	medium-high	26	72	42	1	0	14	113	103	9	0	13	0	0	0.764	0.708	0.864	2	0.0
util	low	low	low	low						3	11											
Direction	low-medium	low	low	low	0	3	0	2	0	3	11	7	2	5	3	0	0	1.214	0.333	1.0	0	0.0

After



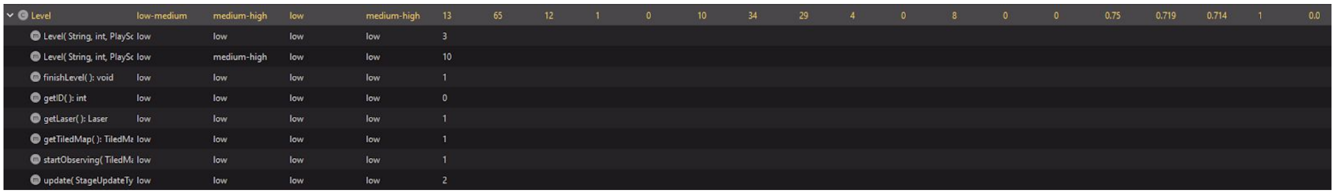
DbConnection	low	low	low	low	0	9	5	1	0	8	24	17	1	4	4	0	0	0.8	0.5	0.0	0	0.0
UserDao	low-medium	low	low-medium	low	2	27	18	1	0	23	105	103	1	0	8	0	0	0.0	0.458	0.25	1	0.0
game	low	low	low-medium	low						44	149											
GridCell	low-medium	low	low	low-medium	5	17	9	2	0	7	21	18	2	0	5	0	2	0.625	0.686	0.6	1	0.8
LaserReflection	low-medium	low	low	low	2	5	2	2	0	3	19	9	1	7	3	0	0	1.75	0.0	0.667	0	0.0
Level	low-medium	medium-high	low	medium-high	13	65	12	1	0	10	34	29	4	0	8	0	0	0.75	0.719	0.714	1	0.0
Player	low	low	low	low	0	5	0	1	0	5	14	11	2	0	5	0	0	0.5	0.2	0.4	0	0.0
StageObserver	low	low	low	low	1	1	0	1	2	1	2	1	0	0	1	0	0	0.0	0.0	0.0	0	0.0
TiledMapInputListener	low-medium	low	low	low	2	6	2	3	0	3	10	8	1	0	3	0	1	0.0	0.5	0.0	0	1.0
TiledMapStage	low-medium	medium-high	low	medium-high	13	28	22	3	0	15	49	40	5	0	10	0	0	0.771	0.77	0.571	1	0.0
objects	low	low-medium	medium-high	low						70	207											
AirTile	medium-high	low-medium	low	low	8	17	7	4	0	4	10	9	0	0	2	0	1	0.0	0.375	0.0	2	2.0
BombTile	medium-high	low	low	low	5	6	3	4	0	2	7	6	0	0	2	0	0	0.0	0.333	0.0	1	0.0
Clickable	low	low	low	low	1	1	0	1	2	1	2	1	0	0	1	0	0	0.0	0.0	0.0	0	0.0
LampTile	medium-high	low	low	low	4	9	4	4	0	5	15	13	1	0	3	0	0	0.0	0.444	0.0	1	0.0
Laser	low	medium-high	low-medium	low-medium	14	31	26	1	0	18	60	52	6	0	5	0	0	0.556	0.7	0.5	1	0.0
Material	low-medium	low	low	low	0	3	1	2	0	5	13	9	1	6	2	1	0	1.286	0.167	1.0	0	0.0
MirrorTile	low-medium	low-medium	low	low	9	21	10	3	0	16	49	48	0	0	4	0	1	0.0	0.6	0.0	1	0.75
OpaqueStaticTile	low-medium	low	low	low	2	2	0	3	2	2	6	5	0	0	2	0	0	0.0	0.333	0.0	0	0.0
Tile	low-medium	low	low	medium-high	5	10	3	2	3	7	17	14	2	0	7	0	0	0.667	0.735	0.905	0	0.0
TileFactory	low	low-medium	low	low	8	8	5	1	0	8	22	20	1	0	4	0	0	0.0	0.437	0.667	1	0.0
TransparentTile	low-medium	low	low	low	2	2	0	3	2	2	6	5	0	0	2	0	0	0.0	0.333	0.0	0	0.0
screens	low	low	low-medium	low						44	375											
AuthenticationScreen	low	medium-high	low-medium	low-medium	19	38	30	1	0	8	116	108	7	0	8	0	0	0.607	0.656	0.75	1	0.0
LevelSelectScreen	low	medium-high	low-medium	low-medium	16	45	24	1	0	11	75	67	7	0	8	0	0	0.714	0.7	0.75	0	0.0
MenuScreen	low	medium-high	low-medium	low-medium	16	28	20	1	0	8	84	77	6	0	8	0	0	0.708	0.7	0.75	0	0.0
PlayScreen	low-medium	medium-high	low-medium	low-medium	18	73	24	1	0	14	65	56	8	0	12	0	0	0.696	0.7	0.822	2	0.0
SettingsMenuScreen	medium-high	medium-high	low	low	11	12	10	5	0	3	35	34	0	0	3	0	0	0.0	0.333	0.0	0	0.0

Level.java Before



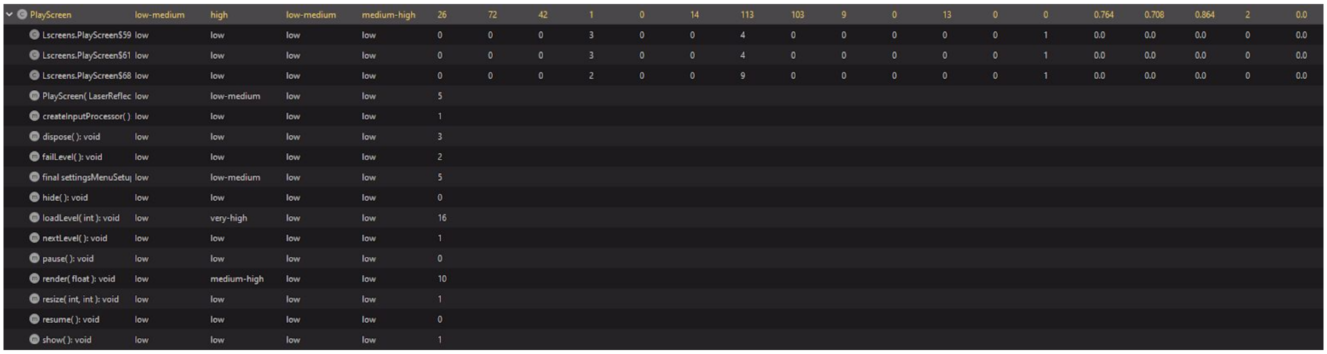
Level	low-medium	medium-high	low	medium-high	14	76	14	1	0	10	36	30	5	0	7	0	0	0.733	0.75	0.571	1	0.0
Level(String, int, PlaySc	low	very-high	low	low	11																	
finishLevel( ): void	low	low	low	low	2																	
getID( ): int	low	low	low	low	0																	
getLaser( ): Laser	low	low	low	low	1																	
getTiledMap( ): TiledMa	low	low	low	low	1																	
startObserving(TiledMa	low	low	low	low	1																	
update(StageUpdateTy	low	low	low	low	2																	

Level.java After



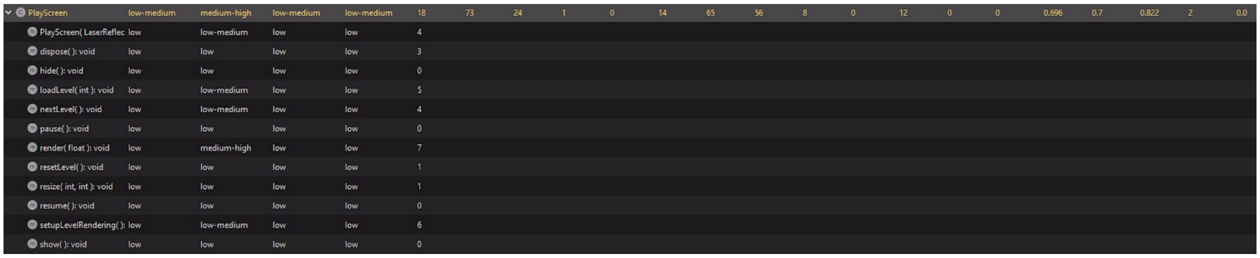
Level	low-medium	medium-high	low	medium-high	13	65	12	1	0	10	34	29	4	0	8	0	0	0.75	0.719	0.714	1	0.0
Level(String, int, PlaySc	low	low	low	low	3																	
Level(String, int, PlaySc	low	medium-high	low	low	10																	
finishLevel( ): void	low	low	low	low	1																	
getID( ): int	low	low	low	low	0																	
getLaser( ): Laser	low	low	low	low	1																	
getTiledMap( ): TiledMa	low	low	low	low	1																	
startObserving(TiledMa	low	low	low	low	1																	
update(StageUpdateTy	low	low	low	low	2																	

PlayScreen.java Before



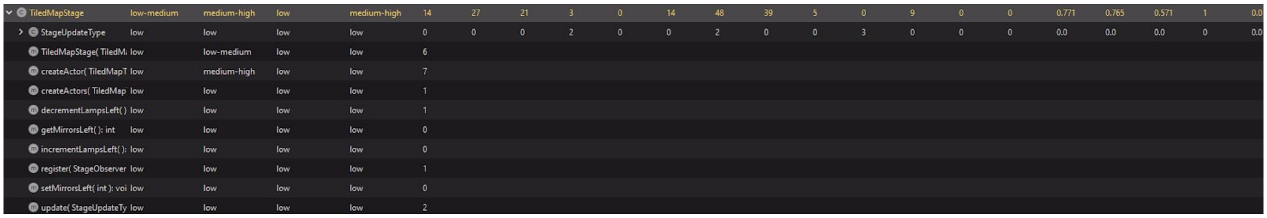
PlayScreen	low-medium	high	low-medium	medium-high	26	72	42	1	0	14	113	103	9	0	13	0	0	0.764	0.708	0.864	2	0.0
Lscreens.PlayScreen$59	low	low	low	low	0	0	0	3	0	0	4	0	0	0	0	0	1	0.0	0.0	0.0	0	0.0
Lscreens.PlayScreen$61	low	low	low	low	0	0	0	3	0	0	4	0	0	0	0	0	1	0.0	0.0	0.0	0	0.0
Lscreens.PlayScreen$68	low	low	low	low	0	0	0	2	0	0	9	0	0	0	0	0	1	0.0	0.0	0.0	0	0.0
PlayScreen(LaserReflec	low	low-medium	low	low	5																	
createInputProcessor( )	low	low	low	low	1																	
dispose( ): void	low	low	low	low	3																	
failLevel( ): void	low	low	low	low	2																	
final settingsMenuSetu	low	low-medium	low	low	5																	
hide( ): void	low	low	low	low	0																	
loadLevel(int): void	low	very-high	low	low	16																	
nextLevel( ): void	low	low	low	low	1																	
pause( ): void	low	low	low	low	0																	
render(float): void	low	medium-high	low	low	10																	
resize(int, int): void	low	low	low	low	1																	
resume( ): void	low	low	low	low	0																	
show( ): void	low	low	low	low	1																	

PlayScreen.java After



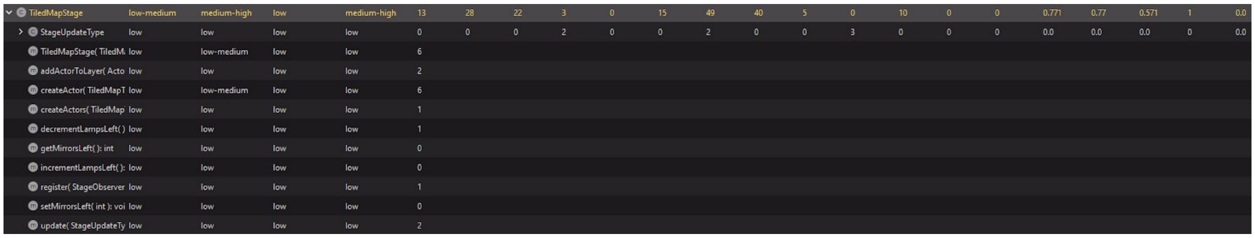
PlayScreen	low-medium	medium-high	low-medium	low-medium	18	73	24	1	0	14	65	56	8	0	12	0	0	0.696	0.7	0.822	2	0.0
PlayScreen(LaserReflec	low	low-medium	low	low	4																	
dispose( ): void	low	low	low	low	3																	
hide( ): void	low	low	low	low	0																	
loadLevel(int): void	low	low-medium	low	low	5																	
nextLevel( ): void	low	low-medium	low	low	4																	
pause( ): void	low	low	low	low	0																	
render(float): void	low	medium-high	low	low	7																	
resetLevel( ): void	low	low	low	low	1																	
resize(int, int): void	low	low	low	low	1																	
resume( ): void	low	low	low	low	0																	
setupLevelRendering( ):	low	low-medium	low	low	6																	
show( ): void	low	low	low	low	0																	

TiledMapStage.java Before



TiledMapStage	low-medium	medium-high	low	medium-high	14	27	21	3	0	14	48	39	5	0	9	0	0	0.771	0.765	0.571	1	0.0
StageUpdateType	low	low	low	low	0	0	0	2	0	0	2	0	0	3	0	0	0	0.0	0.0	0.0	0	0.0
TiledMapStage(TiledMa	low	low-medium	low	low	6																	
createActor(TiledMapT	low	medium-high	low	low	7																	
createActors(TiledMap	low	low	low	low	1																	
decrementLampsLeft( )	low	low	low	low	1																	
getMirrorsLeft( ): int	low	low	low	low	0																	
incrementLampsLeft( ):	low	low	low	low	0																	
register(StageObserver	low	low	low	low	1																	
setMirrorsLeft(int): voi	low	low	low	low	0																	
update(StageUpdateTy	low	low	low	low	2																	

TiledMapStage.java After



TiledMapStage	low-medium	medium-high	low	medium-high	13	28	22	3	0	15	49	40	5	0	10	0	0	0.771	0.77	0.571	1	0.0
StageUpdateType	low	low	low	low	0	0	0	2	0	0	2	0	0	3	0	0	0	0.0	0.0	0.0	0	0.0
TiledMapStage(TiledMa	low	low-medium	low	low	6																	
addActorToLayer(Acto	low	low	low	low	2																	
createActor(TiledMapT	low	low-medium	low	low	6																	
createActors(TiledMap	low	low	low	low	1																	
decrementLampsLeft( )	low	low	low	low	1																	
getMirrorsLeft( ): int	low	low	low	low	0																	
incrementLampsLeft( ):	low	low	low	low	0																	
register(StageObserver	low	low	low	low	1																	
setMirrorsLeft(int): voi	low	low	low	low	0																	
update(StageUpdateTy	low	low	low	low	2																	

Methods refactored:

Level.Level() (constructor)
This constructor method was marked as having “very high” coupling. One of the parameters was an instance of the Player class. This was not necessary however since this logic does not really belong in the level class. We refactored it and moved the logic to the playscreen class. Now the method is marked with “medium high” coupling which is an improvement.

PlayScreen.render()
This method was measured to have a *Coupling Between Objects* (CBO) of 10. But, after reviewing, we found that it contained multiple operations that were unnecessary for its function (example: *Gdx.gl.glClearColor()*). Removing these reduced the CBO to 7. An added bonus is the game’s framerate slightly increased because of this.

PlayScreen.loadLevel()
This method had a very high *Coupling Between Objects* (CBO) value of 17 and a high amount of lines of code. We used *extract method refactoring* to extract the *setupLevelRendering* method, which is responsible for setting up the rendering objects when loading a level. The remainder of the method is now only responsible for loading the level itself and setting up its stage. We also moved the logic responsible for loading the level select screen, when going to a levelID higher than the amount of levels implemented, to the *nextLevel* method, since this is the only case in which this event can occur. After these steps and simplifying a few actions, the method now has a CBO value of 7.

TiledMapStage.createActor()
This method had medium-high coupling before we changed. We used *extract method refactoring* to extract ‘add actor to layer’ logic out to a new method called addActorToLayer since this logic didn’t appear at any other place in the original method. Apart from that, the actor has to listen to the listener for tiled map input and we created an object for that. Since it was unnecessary, we removed the object and directly passed a new TiledMapInputListener object to the method. Thus, we reduced the coupling to low-medium.

Classes refactored:

Class: PlayScreen.java
This class was marked as “problematic” due to its high coupling and lines of code. We used *extract class refactoring* to extract the code relating to the settings menu screen and put it in its own contained class. This reduces the total lines of code in the PlayScreen class, and reduces the coupling for it, as the external classes used for setting up the settings menu are removed from it.

Classes: AirTile.java, LampTile.java and BombTile.java

They all have a medium-high complexity because of high ratings in CBO, access to foreign data(ATFD) and the depth of the inheritance tree(DIT). They can be reduced to low-medium by making them extend Tile instead of TransparentTile and OpaqueTile. However, there is probably merit in keeping the interfaces as it will make it easier for us to extend our game in having more tiles. Keeping this separation in interfaces is reasonable as the behaviour of the tiles can be split into these two interfaces. Therefore, while getting rid of these interfaces will reduce complexity by reducing the above criteria, we find that keeping the interfaces is more logical.