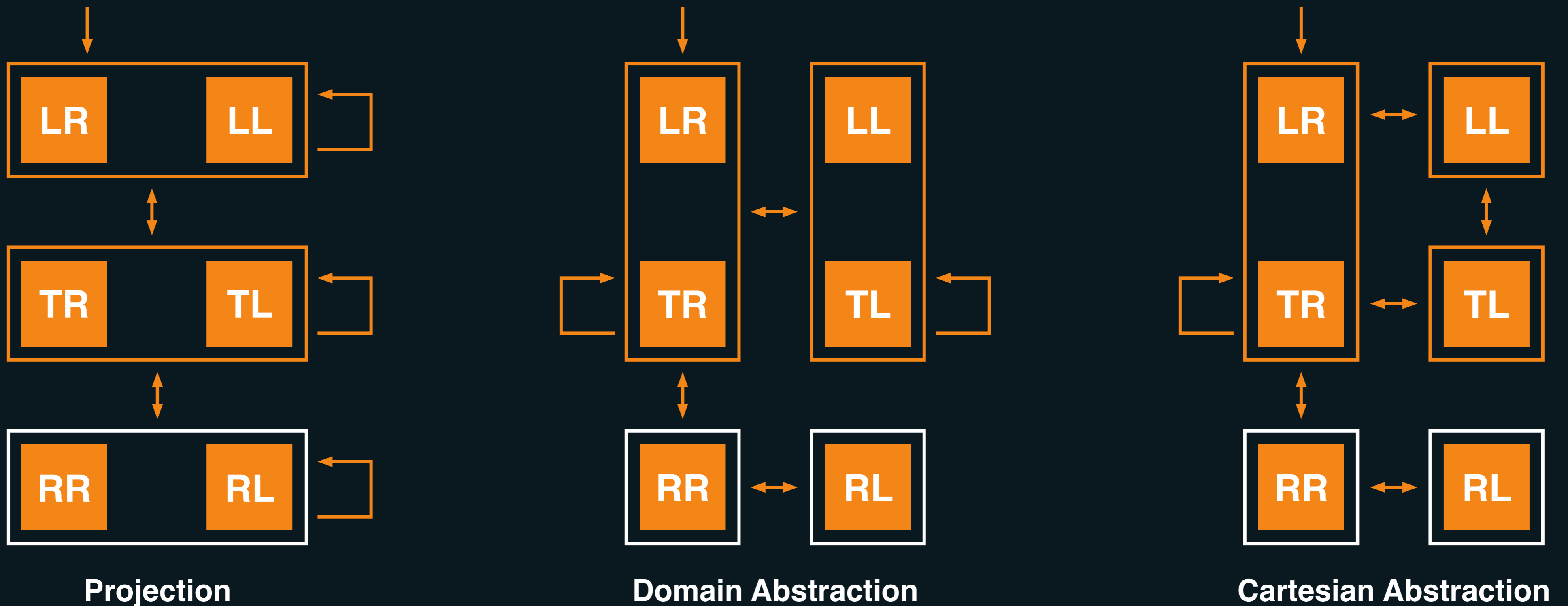


# DOMAIN ABSTRACTIONS

sweet spot between projections and cartesian abstractions?

## abstraction classes

Example abstractions with two variables:  {L(ef), R(ight), T(ruck)}  {L(ef), R(ight)}



## compute domain abstractions

**Algorithm 1: CEGAR for domain abstraction generation**  
**Input:** Planning task  $\Pi$ ; subset of state variables *Blacklist*;  
 variable *InitVar*

**Output:** Domain abstraction  $\alpha$

```
function CEGAR( $\Pi$ , Blacklist, InitVar)
 $\alpha \leftarrow \text{INITIALIZE}(\Pi, \text{InitVar})$ 
while TIME() < MAX_TIME do
 $\pi \leftarrow \text{COMPUTE\_PLAN}(\Pi, \alpha)$ 
Flaws  $\leftarrow \text{FIND\_FLAWS}(\Pi, \pi, \text{Blacklist})$ 
if Flaws =  $\emptyset$  then
break
 $\langle \alpha, \text{Blacklist} \rangle \leftarrow \text{REFINE}(\alpha, \text{Flaws}, \text{Blacklist})$ 
return  $\alpha$ 
```

## Algorithm 2: Refinement of domain abstractions

```
function REFINE( $\alpha$ , Flaws, Blacklist)
 $(v \mapsto d) \leftarrow \text{SELECT\_FLAW}(\text{Flaws})$ 
 $\alpha' \leftarrow \alpha$ 
 $\alpha'_v(d) = \{d\}$  //  $\alpha'_v$  component abstraction for  $v$ 
if RESPECT_SIZE_LIMITS( $\alpha'$ ) then
return  $\langle \alpha', \text{Blacklist} \rangle$ 
else
Blacklist = Blacklist  $\cup \{v\}$ 
return  $\langle \alpha, \text{Blacklist} \rangle$ 
```

- Algorithm 1 called repeatedly to create a diverse set of domain abstractions
- Diversity achieved through different initialisation and refinement strategies

## experimental results

	Rand - GI	MinGr - GI	PDB	Cartesian	coverage
Rand - GI	-	14	28	38	1142.4
MinGr - GI	14	-	32	41	1139.6
PDB	13	9	-	33	1091.5
Cartesian	7	8	13	-	1070.4

Comparison of our best domain abstraction configurations vs. best PDB and Cartesian abstractions

- Best settings for abstraction collection size and single abstraction size were selected before in other experiments
- **GI (Goals - Identity):** diversification technique regarding the initialization of a domain abstraction
- **Rand(om) | MinGr(owth):** diversification techniques regarding fixing a flaw

## comparison with state of the art

	original	+PDBs	+dom	+both
offline Rand				
MinGR	1141.8	1167.8	1158.4 1167.4	1155.5 1166.8
offline Rand				
MinGR	1192.1	1192.1	1172.5 1181.2	1160.0 1169.5

Comparison of Scorpion in its original configuration vs. configurations where we add domain abstractions, PDBs and both



ICAPS 2023 paper:

Computing Domain Abstractions for Optimal Classical Planning  
 with Counterexample-Guided Abstraction Refinement  
 Raphael Kreft, Clemens Büchner, Silvan Sievers, Malte Helmert



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