The original submission unfortunately contains some errors in Lemma 1 and 2. These occurred due to Latex rendering. Specifically, when moving from a text file where the proofs operators including negation, implies, forall and exists were not properly changed to their latex form.

The Lemmas below are identical to the original in the document, but with the proper Latex. This issue will of course also be fixed for an accepted version of the paper.

Lemma 1. *Let Mappings be the predicates returned by ConstructMappings and let G be the RepairConstraint parameter passed into ConstructMappings. Let Prog be the program constructed by Unify using Mappings with a Covering Set Partials. Let S be when Prog satisfies a specification Spec. When any Predicate m in Mappings holds S must hold i.e.* $G \rightarrow (\forall m(Fm \rightarrow S))$.

Proof. Let mi be the ith element in Mappings, 1-indexed.

For the first element of Mappings we have from Branchwise Predicate Synthesis: (1) $G \rightarrow (m1 \rightarrow S)$. We have the validity: (2) $(G \rightarrow (m1 \rightarrow S)) \rightarrow (m1 \rightarrow (G \rightarrow S))$ From which it follows: (3) $(m1 \rightarrow (G \rightarrow S))$.

For the second element we have: (4) $(G \wedge \neg m1) \rightarrow (m2 \rightarrow S)$. Consider that m2 is only evaluated by Prog if m1 is false. Thus we have the following validity: (5) $(((G \wedge \neg m1) \rightarrow (m2 \rightarrow S)) \wedge m2 \wedge \neg m1) \rightarrow (m2 \rightarrow (G \rightarrow S))$. From which it follows: (6) $(m2 \rightarrow (G \rightarrow S))$.

Now let N represent $Nand(m1, ..., mi - 1)$. We then have that for each subsequent element: (7) $(G \wedge N) \rightarrow (mi \rightarrow S)$. Consider that each ith element of Mappings is only evaluated by the program returned if the proceeding i-1 elements were false i.e. N holds. We then have the following validity for each subsequent element in Mappings from 3 to Mappings.Size(): (8) $(((G \wedge N) \rightarrow (mi \rightarrow S)) \wedge mi \wedge N) \rightarrow (mi \rightarrow (G \rightarrow S))$. From which it follows: (9) $(mi \rightarrow (G \rightarrow S))$.

We then have that for each element m in Mappings $(G \rightarrow S)$, thus it follows: (10) $\forall m(Fm \rightarrow (G \rightarrow S))$. We then have the validity: (11) $(\forall m(Fm \rightarrow (G \rightarrow S))) \rightarrow (G \rightarrow (\forall m(Fm \rightarrow S)))$. From which it follows: (12) $G \rightarrow (\forall m(Fm \rightarrow S))$.

Lemma 2. *Let Mappings be the predicates returned by ConstructMappings, let G be the RepairConstraint parameter passed into ConstructMappings and assume G is not equivalent to True. Let p represent an element of a list PartialsSatsHead constructed from Partials, excluding the final element, that contains a predicate that evaluates whether a given program satisfies Spec. Then when no Predicate m in Mappings are true there exist no programs p in PartialsSatsHead that satisfy Spec i.e.* $G \rightarrow (\neg \exists m Fm \rightarrow \neg \exists p Fp)$.

Proof. Since G is not equivalent to true the Unique Correctness restriction is not imposed during construction of Mappings. Let mi be the ith element in Mappings, 1-indexed. Let pi be the ith element in PartialsSatsHead, 1-indexed. Note that Mappings and PartialsSatsHead are the same size. Let E represent whether the final program in Partials satisfies Spec. Let R be the conjunction of the Repair Constraint and the Exists Incorrect constraint: (1) $R \leftrightarrow (\neg(\forall p F p \wedge E) \wedge G)$

For the first element of Mappings we have from Branchwise Predicate Synthesis: (2) $R \rightarrow (p1 \rightarrow m1)$. We have the validity: (3) $(R \rightarrow (p1 \rightarrow m1)) \rightarrow (R \rightarrow (\neg m1 \rightarrow \neg p1))$ From which it follows: (4) $R \rightarrow (\neg m1 \rightarrow \neg p1)$.

For the 2nd element we have: (5) $(R \wedge \neg m1) \rightarrow (p2 \rightarrow m2)$. Consider that m2 is only evaluated in a program if m1 is false. Thus we have the following validity: (6) $(((R \wedge \neg m1) \rightarrow (p2 \rightarrow m2)) \wedge \neg m1) \rightarrow (R \rightarrow (\neg m2 \rightarrow \neg p2))$. From which it follows: (7) $R \rightarrow (\neg m2 \rightarrow \neg p2)$.

Now let N represent $Nand(m1, ..., mi-1)$. We then have that for each subsequent element: (8) $(R \wedge N) \rightarrow (pi \rightarrow mi)$. Consider that each ith element of Mappings is only evaluated if the proceeding i-1 elements were false i.e. N holds. We then have the following validity for each subsequent element in Mappings from 3 to Mappings.Size(): (9) $(((R \wedge N) \rightarrow (pi \rightarrow mi)) \wedge N) \rightarrow (R \rightarrow (\neg mi \rightarrow \neg pi))$. From which it follows: (10) $(R \rightarrow (\neg mi \rightarrow \neg pi))$.

We thus have that given R when every element m in Mappings is false, every element p in PartialsSatsHead must be false: (11) $R \rightarrow (\forall m \neg F m \rightarrow \forall p \neg F p))$. We then have the validity: (12) $(R \rightarrow (\forall m \neg F m \rightarrow \forall p \neg F p)) \rightarrow (R \rightarrow (\neg \exists m F m \rightarrow \neg \exists p F p))$. From which it follows: (13) $R \rightarrow (\neg \exists m F m \rightarrow \neg \exists p F p)$. We then have the following validity: (14) $((R \leftrightarrow (\neg(\forall p F p \wedge E) \wedge G)) \wedge ((R \rightarrow (\neg \exists m F m \rightarrow \neg \exists p F p)))) \rightarrow (G \rightarrow (\neg \exists m F m \rightarrow \neg \exists p F p))$. From which it follows: (15) $G \rightarrow (\neg \exists m F m \rightarrow \neg \exists p F p)$.