

Beeldherkenning & het Papillottenproject

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Inhoud

- **Het Papillottenproject**
- **Taxonomische indeling vlinders**
- **Determinatieproces**
- **Model trainen**
- **Resultaten model V0.1**
- **Testen en hertrainen**
- **Resultaten model V0.2**
- **Problemen & oplossingen**
- **Planning**



(Machine
esai O. 4
nah Abang
H. D. W.
van, Mam-
van, Gang

le petit garçon en fit lav
traine de chambre de l'hôtel.
Emma. Vous, vous êtes belle
une seconde, chère
les pivoines qui
un pivoine.
ait à rir

e rules
he



LA VIE FINAN
CETTE LEYON, soyons-en si
Mais, aujourd'hui, elle se pr
ent un fait d'exp



Le ten
dans
Le ten
dans
Le ten
dans



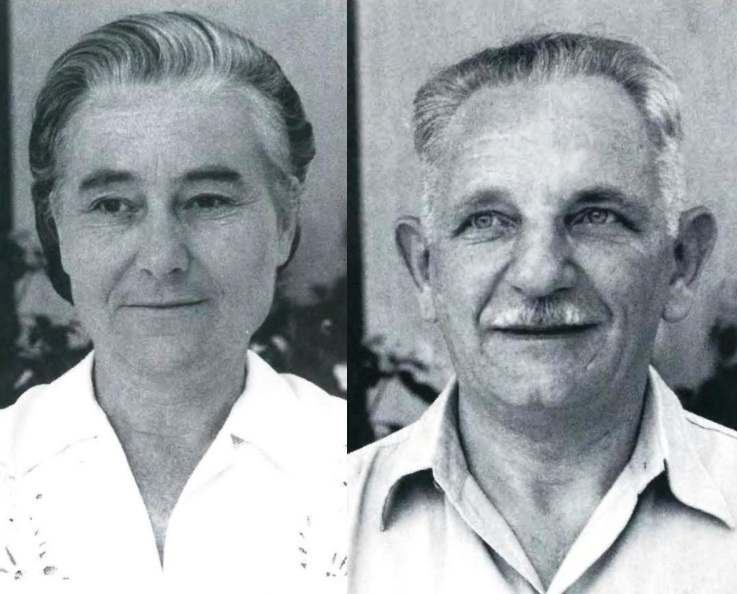
zal het oordeel
bekend gemaakt.
den alsmede van

Average 1-3 off
Reductions



307
KARL EMMER
pourront, en mangeant le fruit désas-
tré du ciel à travers les dernières
ment immobiles et cois!
de cette exaltation.

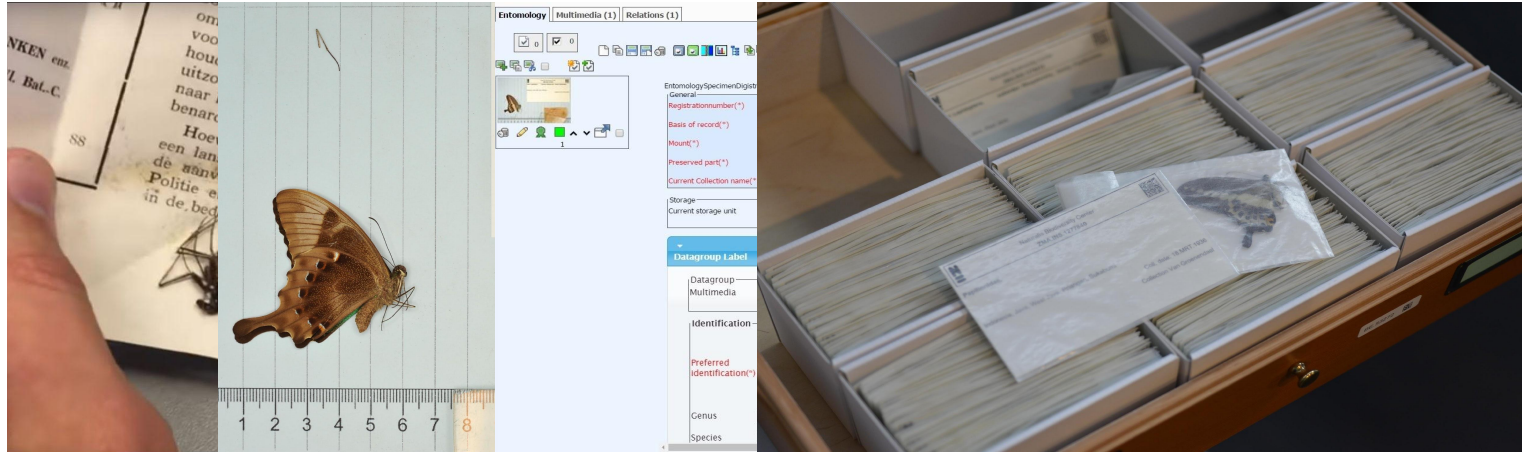
LA VIE FINAN
CETTE LEYON, soyons-en si
Mais, aujourd'hui, elle se pr
ent un fait d'exp



Foto's Van Groenendaal, uit: A.J. de Boer (1998)

Werkstraat

Fotograferen + registreren + archiveren



Werkstraat

Fotograferen + registreren + archiveren

Live Science



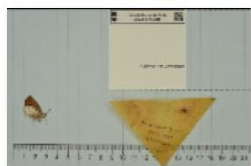
3 werkstations, 21 vrijwilligers, 7 dagen in de week, interactie met publiek

Collectie Laboratorium (sinds aug 2020):



2 nieuwe werkstations, 10 vrijwilligers, 5 dagen in de week.

Beeldmateriaal: 170.000 ongedetermineerd, verschillende families



ZMA.INS.1354649_1



ZMA.INS.1354650_1



ZMA.INS.1354651_1



ZMA.INS.1354652_1



ZMA.INS.1354653_1



ZMA.INS.1354654_1



ZMA.INS.1354655_1



ZMA.INS.1354656_1



ZMA.INS.1354657_1



ZMA.INS.1354658_1



ZMA.INS.1354659_1



ZMA.INS.1354660_1



ZMA.INS.1354661_1



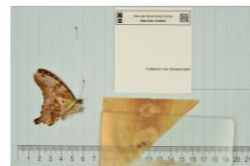
ZMA.INS.1354662_1



ZMA.INS.1354663_1



ZMA.INS.1354664_1



ZMA.INS.1354665_1



ZMA.INS.1354666_1



ZMA.INS.1354667_1



ZMA.INS.1354668_1



ZMA.INS.1354669_1



ZMA.INS.1354670_1



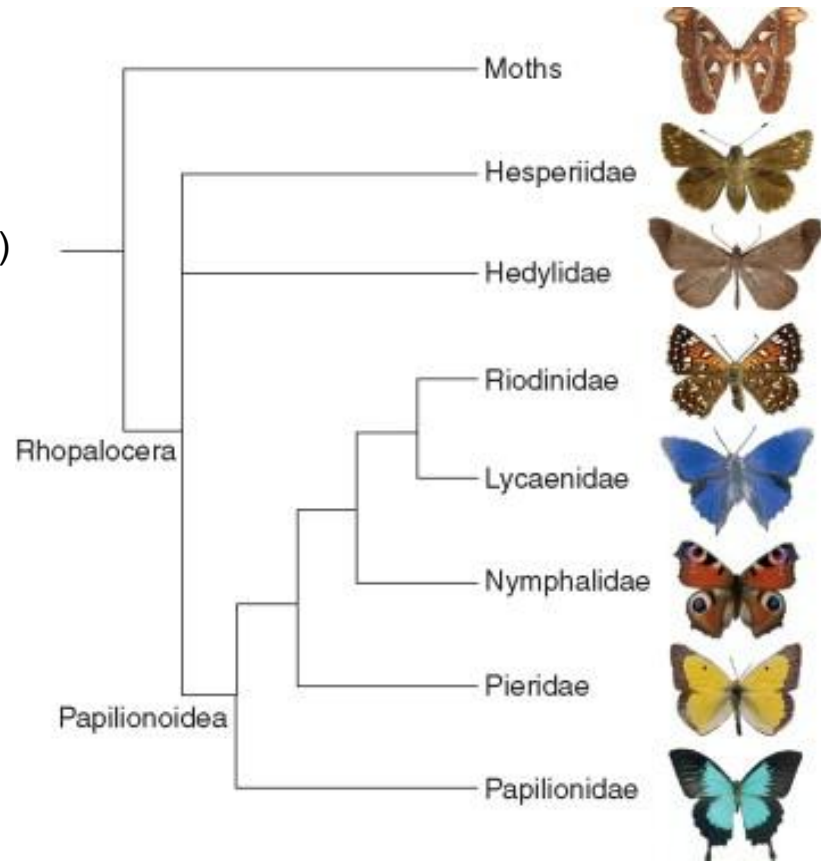
ZMA.INS.1354671_1



ZMA.INS.1354672_1

Dagvlinders: taxonomische indeling

- ❖ Rijk: Animalia (Dieren)
 - Stam: Arthropoda (Geleedpotigen)
 - Klasse: Insecta (Insecten)
 - Orde: Lepidoptera (Vlinders)

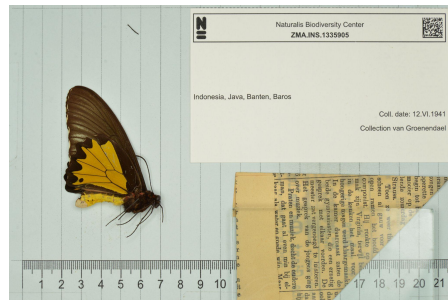
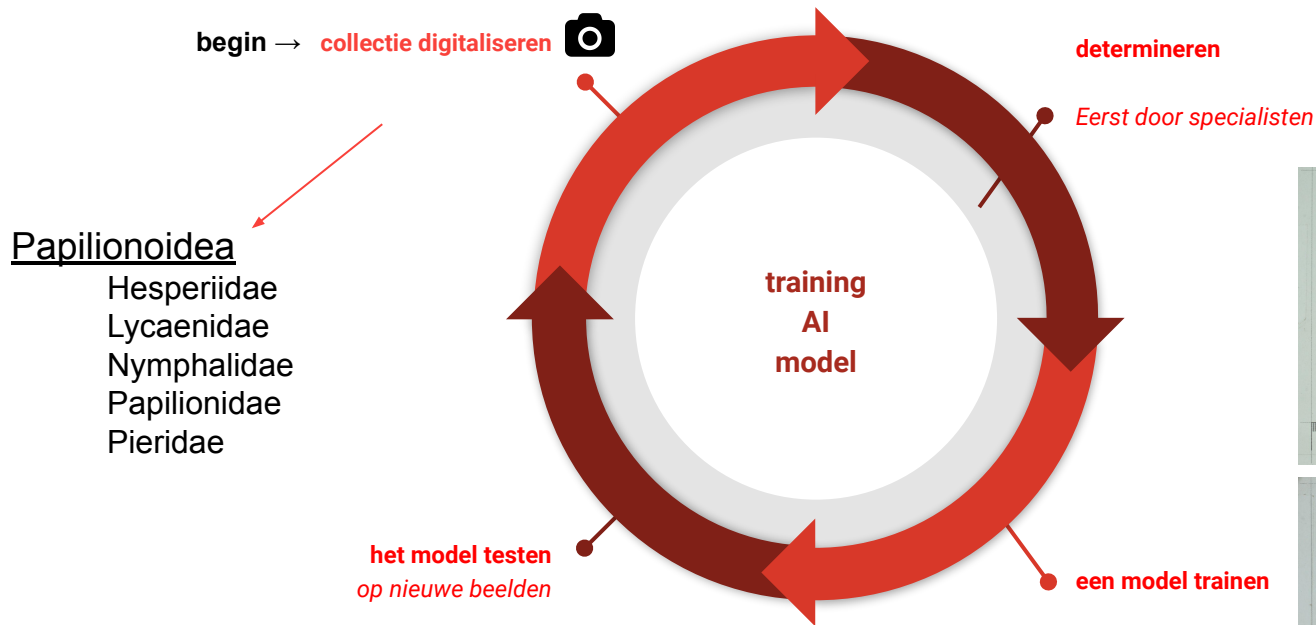


Dagvlinders: taxonomische indeling

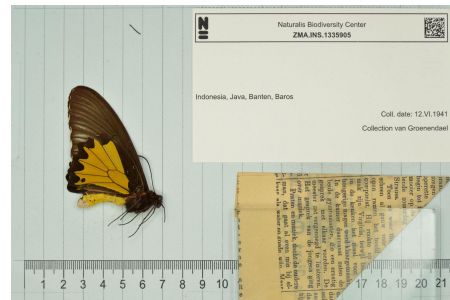
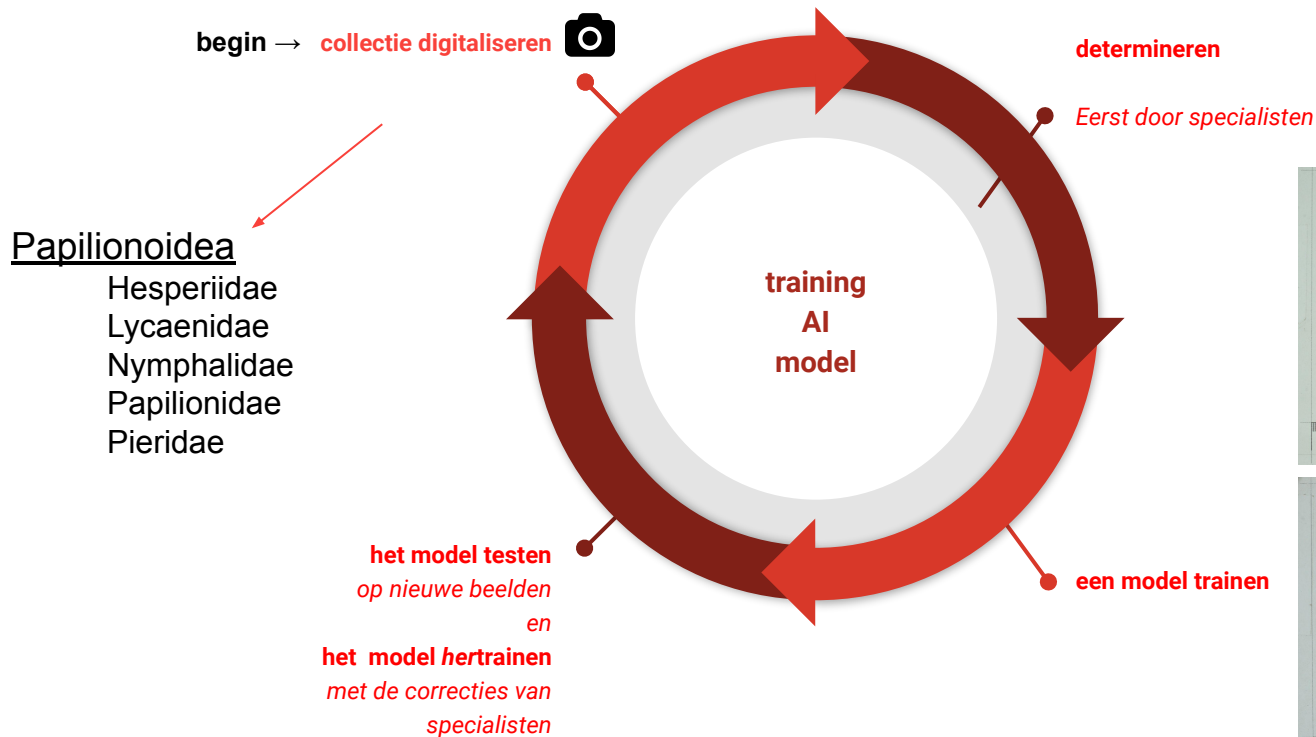
- ▼ superfamily: *Papilionoidea*
 - ▼ family: *Lycaenidae*
 - ▶ genus: *Abisara*
 - ▶ genus: *Abloxurina*
 - ▼ genus: *Acesina*
 - ▼ species: *Acesina paraganesa* (De Nicéville, 1882)
 - infraspecific name: *Acesina paraganesa dusunensis* (Barlow, Banks & Holloway, 1971)
 - infraspecific name: *Acesina paraganesa mendava* (Corbet, 1941)
 - species: *Acesina zephyretta* Doherty, 1891
 - ▶ genus: *Acrodipsas*
 - ▶ genus: *Actis*
 - ▶ genus: *Actizera*
 - ▶ genus: *Acupicta*
 - ▶ genus: *Acytolepis*
 - ▶ genus: *Adaluma*
 - ▶ genus: *Adelotypa*



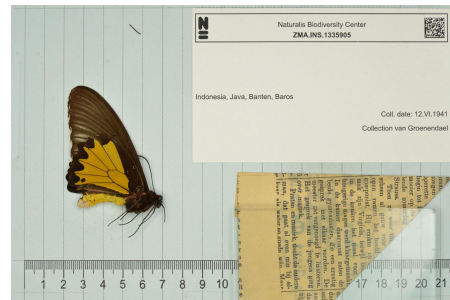
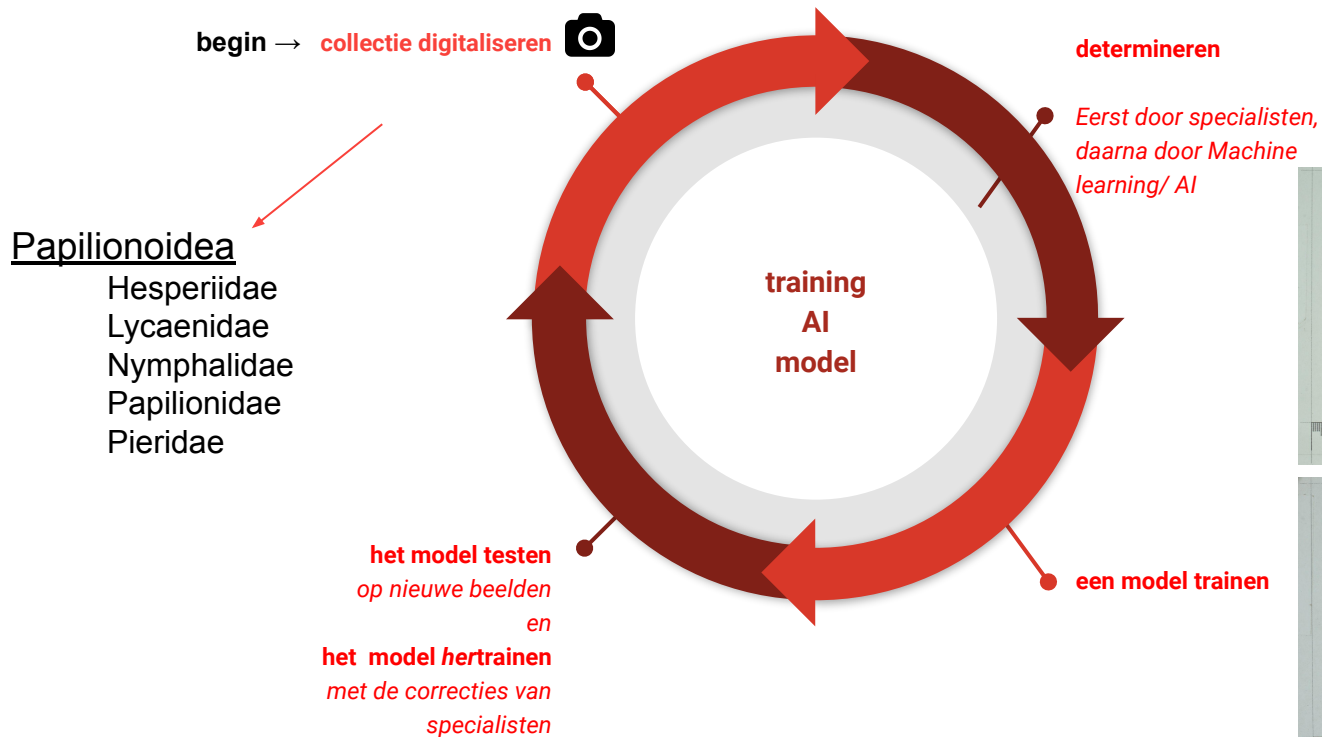
Een model trainen



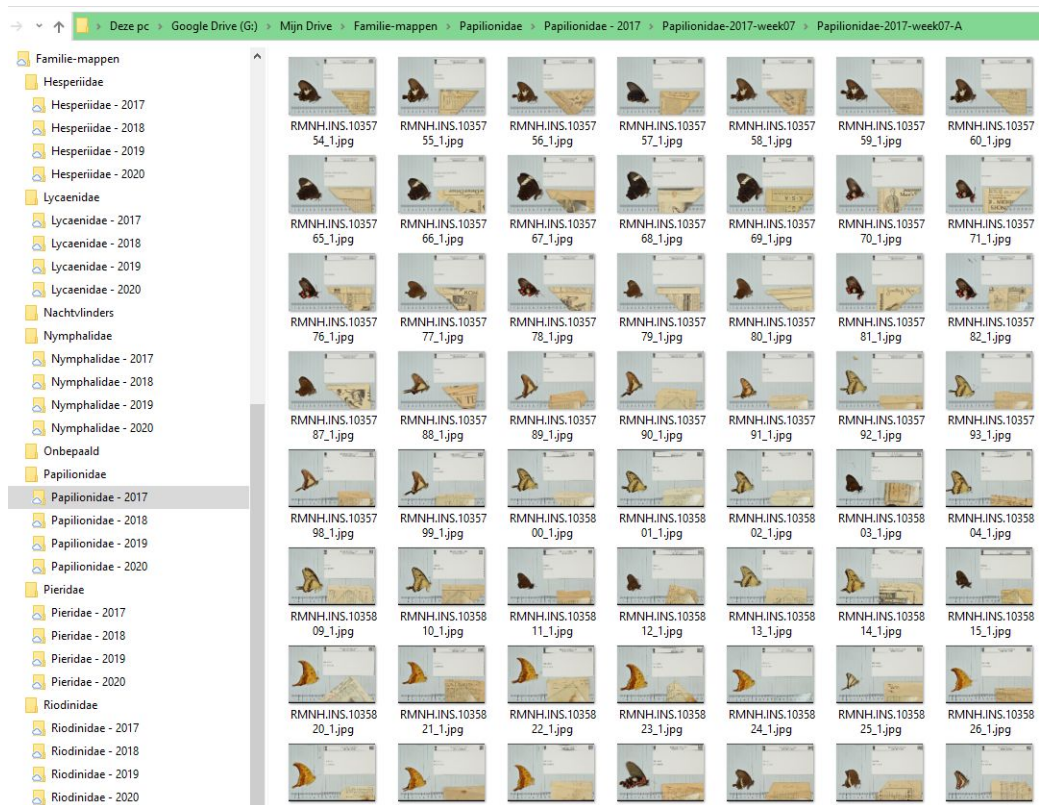
Een model trainen



Een model trainen



Een model trainen - stap 1



Selecteren familie-niveau



Determinatie specialisten



Data normaliseren



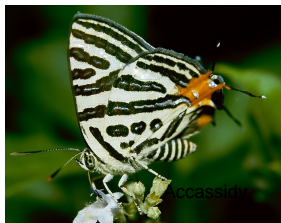
Importeren in CRS



Model trainen

Model Papillotten v0.1

Trainen met determinaties specialisten



Identificaties dagvlinders (totaal 15.690)

Hesperiidae

2,5%

Lycaenidae

12,2%

Riodinidae

0,2%

Nymphalidae

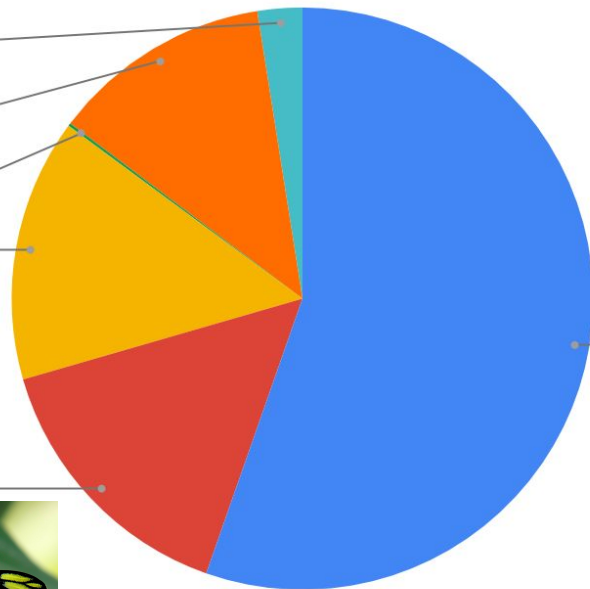
14,6%

Pieridae

15,2%



By © 2010 Jee
& Rani Nature



Papilionidae

55,4%

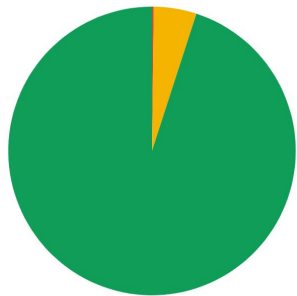


By User Fir0002

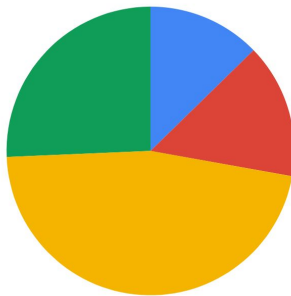
Model Papillotten v0.1

Trainen met determinaties specialisten

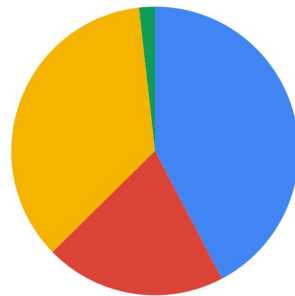
Papilionidae



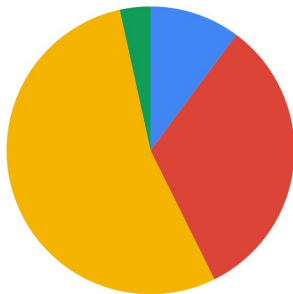
Pieridae



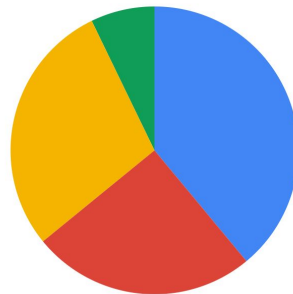
Nymphalidae



Lycaenidae



Hesperiidae

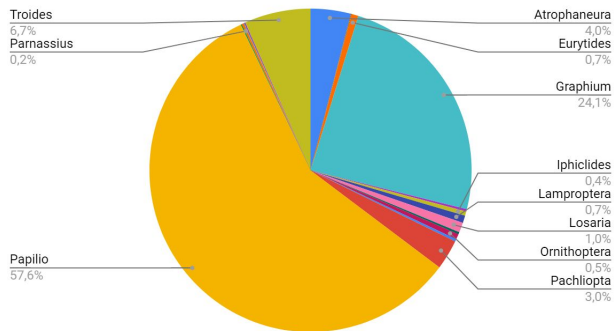


● Tot familie ● Tot genus ● Tot soort ● Tot ondersoort

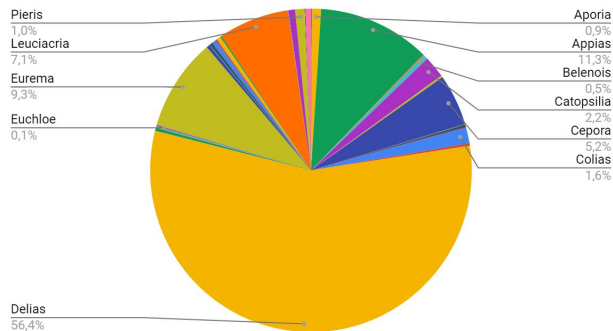
Model Papillotten v0.1

Trainen met determinaties specialisten

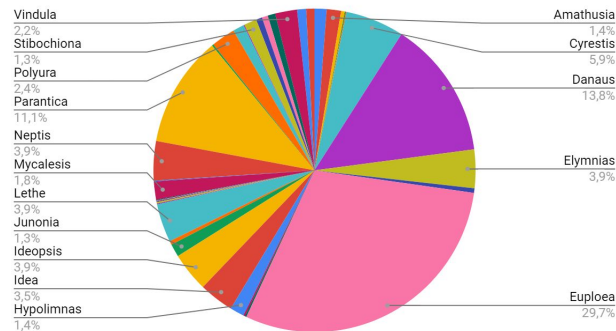
Papilionidae



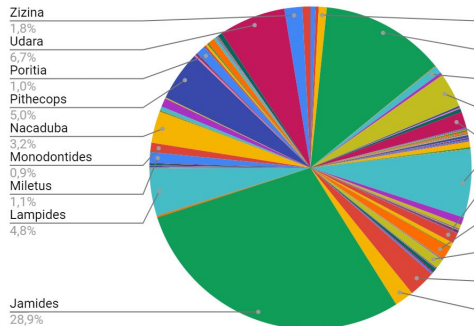
Pieridae



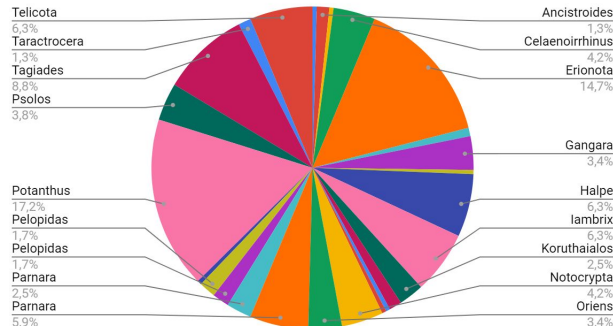
Nymphalidae



Lycaenidae



Hesperiidae



Model Papillotten v0.1

Resultaten

Downloaded images	8,507
Classes (species and subspecies)	123
Minimum / maximum images per class	2 ... (no max)
Accuracy	95%
Average precision	91%
Average recall	95%



Accuracy: overall percentage of correct identifications.

Precision: percentage of images identified as taxon X that are truly X.

Recall: percentage of images that are truly taxon X correctly identified as X.

Model Papillotten v0.1

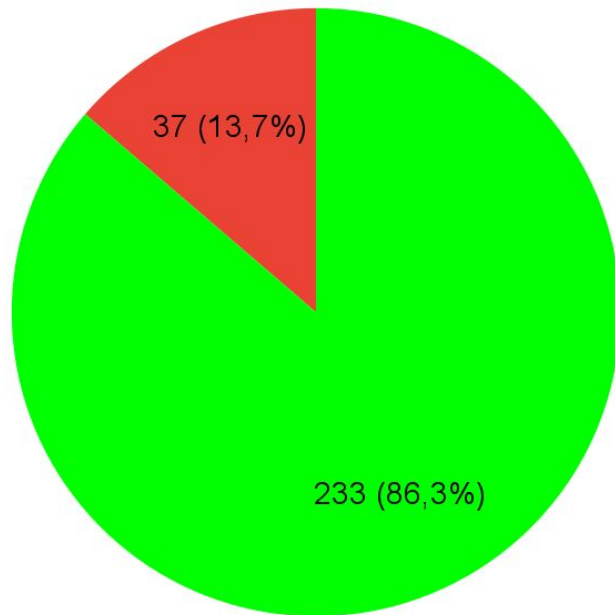
Testen door specialisten

Test results											
Class #1	Prediction #1	Specialist agrees #1?	Class #2	Prediction #2	Specialist agrees #2?	Class #3	Prediction #3	Specialist agrees #3?	Correcties Jan Moonen		
Troides (Troides) amphrysus amphrysus	0,4654963613	disagree	Danaus genutia (Cramer, 1779)	0,07980772853	disagree	Ornithoptera (Ornithoptera) priamus l	0,04943197966	disagree	Troides (Troides) cuneifera cuneifera Oberthür, 1879		
Troides (Troides) vandepolli vandepolli	0,1752076149	agree	Troides (Troides) helena helena	0,1563224494	disagree	Papilio (Menelaides) helenus enganius	0,1535060412	disagree	Troides (Troides) vandepolli vandepolli (Snellen, 1890)		
Papilio (Achillides) paris gedeensis Fru	0,4027338922	agree	Papilio (Menelaides) helenus eng	0,1264576763	disagree	Papilio (Menelaides) ambrax ambrax B	0,08443467319	disagree	Papilio (Achillides) paris gedeensis Fruhstorfer, 1893		
Papilio (Menelaides) helenus enganius	0,1041145325	disagree	Troides (Troides) vandepolli vanc	0,09245790541	agree	Papilio (Menelaides) memnon memno	0,08776370436	disagree	Troides (Troides) vandepolli vandepolli (Snellen, 1890)		
Papilio (Menelaides) demolion demolion	0,5829994678	agree	Papilio (Menelaides) polytes java	0,02728834189	disagree	Ornithoptera (Ornithoptera) priamus l	0,02641369775	disagree	Papilio (Menelaides) demolion demolion Cramer, 1776		
Papilio (Menelaides) helenus enganius	0,5821180344	agree	Papilio (Menelaides) polytes java	0,06980444491	disagree	Papilio (Achillides) paris gedeensis Fru	0,03544579074	disagree	Papilio (Menelaides) helenus enganius Doherty, 1891		
Papilio (Achillides) paris gedeensis Fru	0,5388030248	agree	Papilio (Menelaides) polytes java	0,07332477719	disagree	Papilio (Menelaides) helenus enganius	0,07113503665	disagree	Papilio (Achillides) paris gedeensis Fruhstorfer, 1893		
Papilio (Achillides) paris gedeensis Fru	0,4609123766	agree	Papilio (Menelaides) helenus eng	0,0747224018	disagree	Papilio (Menelaides) polytes javanus Fi	0,04465544969	disagree	Papilio (Achillides) paris gedeensis Fruhstorfer, 1893		
Atrophaneura (Atrophaneura) priapus	0,6901862621	agree	Atrophaneura (Atrophaneura) pri	0,03270253539	disagree	Ornithoptera (Ornithoptera) priamus l	0,02791012265	disagree	Atrophaneura (Atrophaneura) priapus priapus (Boisdauv		
Atrophaneura (Atrophaneura) priapus	0,3465262055	disagree	Papilio (Menelaides) demolion de	0,2567528486	disagree	Papilio (Menelaides) memnon memno	0,05705281347	disagree	Atrophaneura (Atrophaneura) priapus priapus (Boisdauv		
Papilio (Achillides) karna karna Felder	0,5153019428	disagree	Papilio (Menelaides) helenus eng	0,1309720576	disagree	Papilio (Achillides) paris gedeensis Fru	0,09095799217	agree	Papilio (Achillides) paris gedeensis Fruhstorfer, 1893		
Atrophaneura (Atrophaneura) priapus	0,4809915423	agree	Papilio (Menelaides) helenus eng	0,1107730865	disagree	Graphium (Graphium) anthedon milon	0,06394787875	disagree	Atrophaneura (Atrophaneura) priapus priapus (Boisdauv		
Papilio (Achillides) paris gedeensis Fru	0,6553215384	agree	Papilio (Menelaides) helenus eng	0,06799878925	disagree	Papilio (Achillides) karna karna Felder	0,04947151989	disagree	Papilio (Achillides) paris gedeensis Fruhstorfer, 1893		
Papilio (Achillides) karna karna Felder	0,6412086487	agree	Papilio (Menelaides) ambrax aml	0,07597921044	disagree	Papilio (Menelaides) aegaeus ormenus	0,05865381286	disagree	Papilio (Achillides) karna karna Felder & Felder, 1864		
Papilio (Achillides) paris gedeensis Fru	0,7404011488	agree	Papilio (Menelaides) ambrax aml	0,03920086101	disagree	Papilio (Menelaides) polytes javanus Fi	0,0236638952	disagree	Papilio (Achillides) paris gedeensis Fruhstorfer, 1893		
Papilio (Menelaides) helenus enganius	0,4867534637	agree	Papilio (Menelaides) polytes java	0,07614171505	disagree	Papilio (Menelaides) demolion demoli	0,04936571047	disagree	Papilio (Menelaides) helenus enganius Doherty, 1891		
Papilio (Achillides) paris gedeensis Fru	0,6592108001	agree	Papilio (Menelaides) helenus eng	0,02470894344	disagree	Papilio (Menelaides) polytes javanus Fi	0,01323408075	disagree	Papilio (Achillides) paris gedeensis Fruhstorfer, 1893		
Papilio (Achillides) paris gedeensis Fru	0,4152513742	agree	Papilio (Menelaides) helenus eng	0,1287195832	disagree	Papilio (Menelaides) polytes javanus Fi	0,05171792209	disagree	Papilio (Achillides) paris gedeensis Fruhstorfer, 1893		
Papilio (Achillides) paris gedeensis Fru	0,9061700702	agree	Papilio (Menelaides) helenus eng	0,03481483502	disagree	Papilio (Menelaides) memnon memno	0,01508864108	disagree	Papilio (Achillides) paris gedeensis Fruhstorfer, 1893		
Papilio (Achillides) paris gedeensis Fru	0,3954567313	agree	Papilio (Menelaides) helenus eng	0,2559930666	disagree	Papilio (Menelaides) polytes javanus Fi	0,05456652865	disagree	Papilio (Achillides) paris gedeensis Fruhstorfer, 1893		
Troides (Troides) cuneifera cuneifera C	0,1794322431	agree	Pachioptera adamas adamas Zino	0,051028613	disagree	Parantica aspasia (Fabricius, 1787)	0,04714202136	disagree	Troides (Troides) cuneifera cuneifera Oberthür, 1879		
Papilio (Achillides) paris gedeensis Fru	0,6551356316	agree	Papilio (Menelaides) helenus eng	0,1105897278	disagree	Papilio (Menelaides) polytes javanus Fi	0,03068258427	disagree	Papilio (Achillides) paris gedeensis Fruhstorfer, 1893		
Atrophaneura (Atrophaneura) priapus	0,4239298403	agree	Graphium (Graphium) anthedon	0,1808433235	disagree	Papilio (Menelaides) helenus enganius	0,054204016714	disagree	Atrophaneura (Atrophaneura) priapus priapus (Boisdauv		
Papilio (Achillides) paris gedeensis Fru	0,8247944117	agree	Papilio (Menelaides) helenus eng	0,03916793689	disagree	Papilio (Achillides) karna karna Felder	0,03878860921	disagree	Papilio (Achillides) paris gedeensis Fruhstorfer, 1893		
Papilio (Achillides) paris gedeensis Fru	0,19625476	disagree	Papilio (Menelaides) helenus eng	0,1579198837	disagree	Papilio (Achillides) karna karna Felder	0,1521353126	agree	Papilio (Achillides) karna karna Felder & Felder, 1864		
Papilio (Achillides) karna karna Felder	0,5639952421	disagree	Papilio (Menelaides) helenus eng	0,09342817217	disagree	Papilio (Achillides) paris gedeensis Fru	0,03959534307	disagree	Papilio (Achillides) karna karna Felder & Felder, 1864		
Papilio (Achillides) karna karna Felder	0,7536628246	disagree	Papilio (Menelaides) helenus eng	0,06336209178	disagree	Papilio (Achillides) paris gedeensis Fru	0,05412532389	disagree	Papilio (Achillides) karna karna Felder & Felder, 1864		
Papilio (Achillides) paris gedeensis Fru	0,5702481004	disagree	Papilio (Menelaides) helenus eng	0,08322609216	disagree	Papilio (Menelaides) polytes javanus Fi	0,03017079644	disagree	Papilio (Achillides) paris gedeensis Fruhstorfer, 1893		
Papilio (Achillides) paris gedeensis Fru	0,6251630783	disagree	Papilio (Menelaides) aegaeus orr	0,1189282835	disagree	Papilio (Menelaides) helenus enganius	0,08522191644	disagree	Papilio (Achillides) paris gedeensis Fruhstorfer, 1893		
Papilio (Achillides) karna karna Felder	0,7449397445	disagree	Papilio (Achillides) paris gedeens	0,08565992862	disagree	Papilio (Menelaides) helenus enganius	0,06099384278	disagree	Papilio (Achillides) karna karna Felder & Felder, 1864		
Papilio (Achillides) paris gedeensis Fru	0,7258642912	disagree	Papilio (Menelaides) helenus eng	0,03488323465	disagree	Papilio (Menelaides) polytes javanus Fi	0,0288890993	disagree	Papilio (Achillides) paris gedeensis Fruhstorfer, 1893		
Papilio (Menelaides) demolion demolion	0,1421739608	disagree	Papilio (Menelaides) polytes java	0,09792356193	disagree	Graphium (Graphium) sarpedon lycan	0,07605314255	disagree	Papilio (Menelaides) demolion demolion Cramer, 1776		
Graphium (Graphium) bathycles bathy	0,2246612331	disagree	Graphium (Graphium) sarpedon	0,1016129255	disagree	Euchrysops onejus (Fabricius, 1798)	0,03668580833	disagree	Graphium (Graphium) bathycles bathycles (Zinken, 1886)		
Papilio (Achillides) karna karna Felder	0,6359047294	disagree	Papilio (Achillides) paris gedeens	0,1457623094	disagree	Papilio (Menelaides) helenus enganius	0,04606592283	disagree	Papilio (Achillides) karna karna Felder & Felder, 1864		
Graphium (Pathysa) antiphates javanic	0,6131139398	disagree	Papilio (Menelaides) helenus eng	0,06627004594	disagree	Papilio (Menelaides) polytes javanus Fi	0,02629563957	disagree	Graphium (Pathysa) antiphates javanicus (Eimer, 1888)		
Troides (Troides) vandepolli vandepolli	0,2705988884	disagree	Troides (Troides) helena helena	0,1192259192	disagree	Troides (Troides) haliphron cf. naia Dc	0,07630004734	disagree	Troides (Troides) vandepolli vandepolli (Snellen, 1890)		

Model Papillotten v0.1

Testen door specialisten

Papilionidae

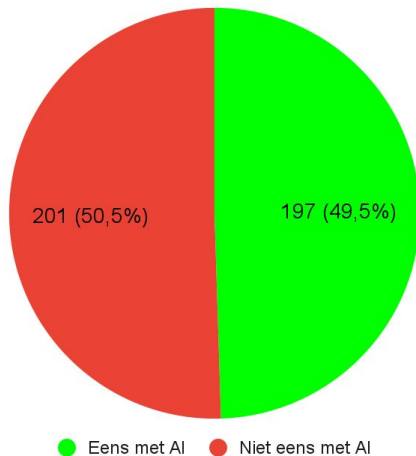


● Eens met AI ● Niet eens met AI

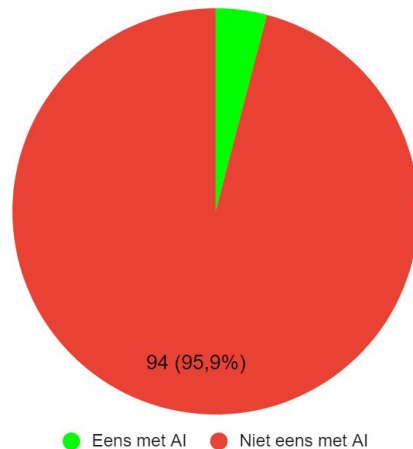
Model Papillotten v0.1

Testen door specialisten

Lycaenidae



Nymphalidae



Model Papillotten v0.1: Test Papilionidae



Model Papillotten v0.2

Hertrainen

De eerste versie van het model is hertraint met additionele gedetermineerde foto's en met de correcties van specialisten.

Data gebruikt

- Papillotten mapping, sheets 1 through 8 (10,099 records)
- Junonia Indonesia (47 records)
- Extra training set_Lycaenidae_24112021 (46 records)
- TestAI_Lycaenidae (179 records)
- TestAI_Nymphalidae (92 records)
- TestAI_Papilionidae (276 records)
- TestAI_Pieridae (262 records)
- TestAI_Hesperiidae (140 records)



Model Papillotten v0.2

Resultaten

Classes (list of classes)	248
Skipped classes (less than 2 images each; list of classes)	124
Minimum / maximum images per class	2 ... (no max)
Support (images used in training/validating)	11,019 (of 11,141)
Accuracy	98.3%
Average precision	97.54%
Average recall	97.25%



Model Papillotten v0.2

Alternatieve modellen: Families en Genera

Families

Model ID	20211214-192106
Training date	2021-12-14 19:21:06
Classes (list of classes)	8
Minimum / maximum images per class	2 ... (no max)
Support (images used in training/validating)	11,143
Accuracy	99,9%
Macro_precision:	99,3%
Macro_recall	91,6%

Genera

Model ID	20211214-094501
Training date	2021-12-14 09:45:01
Classes (list of classes)	107
Minimum / maximum images per class	2 ... (no max)
Support (images used in training/validating)	11,003
Accuracy	98,7%
Macro_precision:	98,8%
Macro_recall	98,5%



Problemen

- Variaties in namen = “schijn” klassen

class	support	F1-score	precision	recall	top 3	top 5
Acraea vesta Fabricius, 1787	28	1.0	1.0	1.0	1.0	1.0
Amathusia phidippus (Linnaeus, 1763)	16	1.0	1.0	1.0	1.0	1.0
Appias (indra)leptis (Felder, 1865)	3	0.0	0.0	0.0	0.0	0.0
Appias indra (lucasi) Moore, 1857	2	1.0	1.0	1.0	1.0	1.0
Appias nero Fabricius, 1793	34	0.97143	0.94444	1.0	1.0	1.0
Atrophaneura (Atrophaneura) nox nox (Swainson, 1822/23)	48	0.9697	0.94118	1.0	1.0	1.0
Atrophaneura (Atrophaneura) priapus (Boisduval, 1836)	2	1.0	1.0	1.0	1.0	1.0
Atrophaneura (Atrophaneura) priapus dilutus (Fruhstorfer, 1895)	3	1.0	1.0	1.0	1.0	1.0
Atrophaneura (Atrophaneura) priapus priapus (Boisduval, 1836)	18	1.0	1.0	1.0	1.0	1.0
Atrophaneura (Losaria) coon coon (Fabricius, 1793)	288	0.93474	0.94982	0.92014	0.93056	0.93403
Atrophaneura coon coon (Fabricius, 1793)	11	0.0	0.0	0.0	0.0	0.0
Delias hyparete (Linnaeus, 1758)	12	1.0	1.0	1.0	1.0	1.0
Delias hyparete Linnaeus, 1758	14	1.0	1.0	1.0	1.0	1.0

Problemen

- Variaties in namen = “schijn” klassen

Oplossing

tijdelijke $\Rightarrow$ name resolver

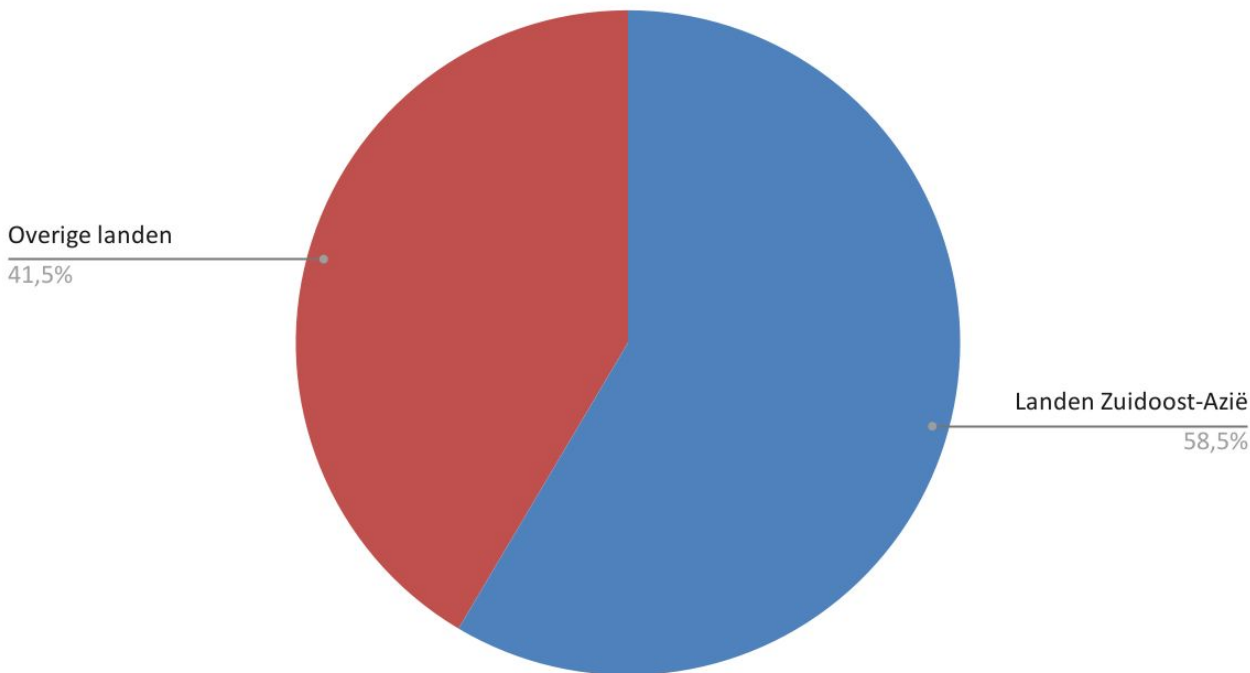
duurzame $\Rightarrow$ data normaliseren via thesauri



Problemen

- Representativiteit referentiemateriaal

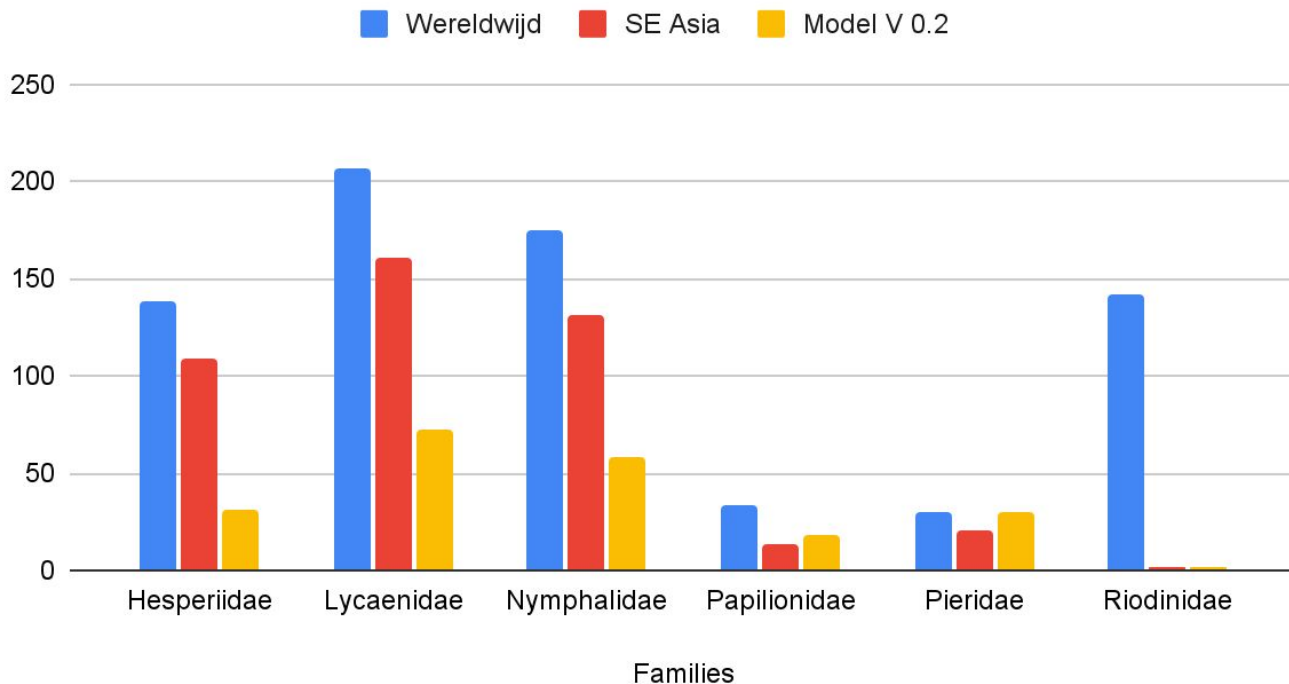
Collectiemateriaal (aantal dozen)



Problemen

- Representativiteit referentiemateriaal

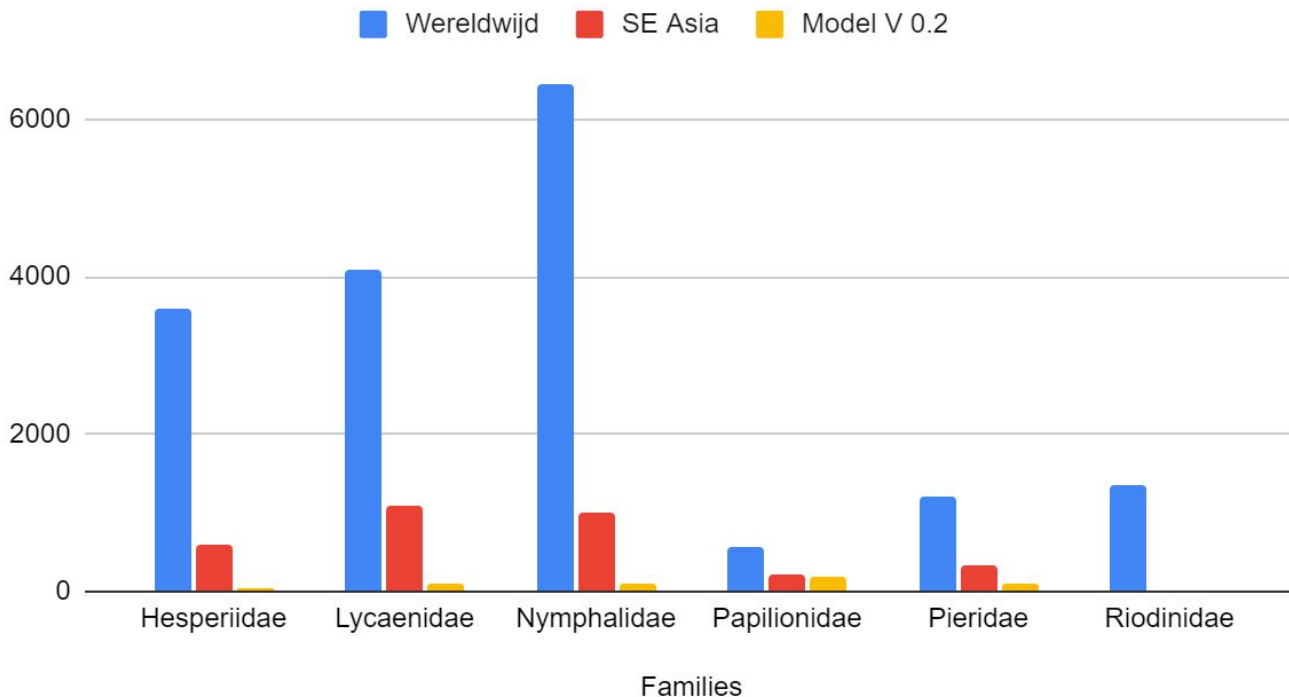
Aantal genera



Uitdagingen

- Representativiteit referentiemateriaal

Aantal soorten



Problemen

- Representativiteit referentiemateriaal

Oplossing

Ongedetermineerde foto's sorteren met
behulp van een “sorteermiddel”

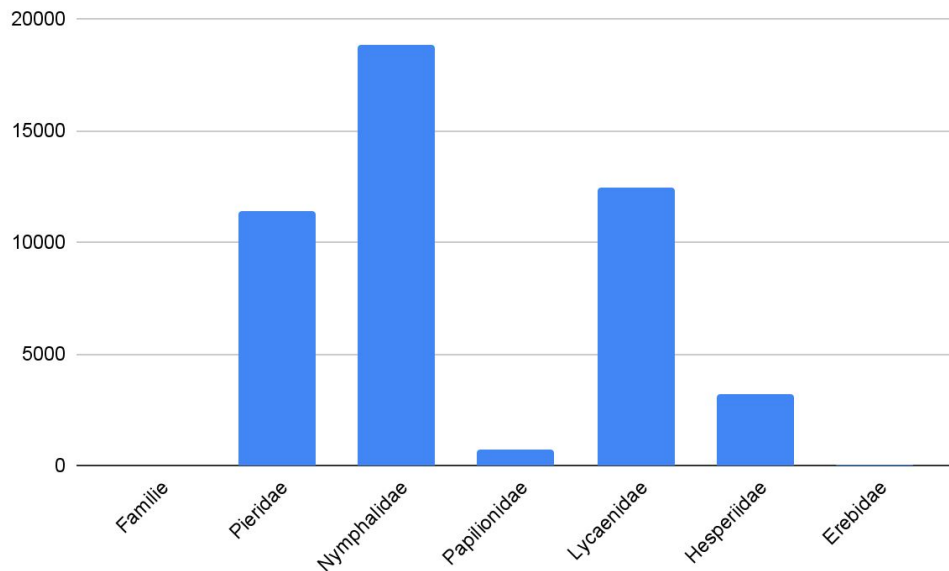


Gesorteerde foto's laten determineren
door specialisten



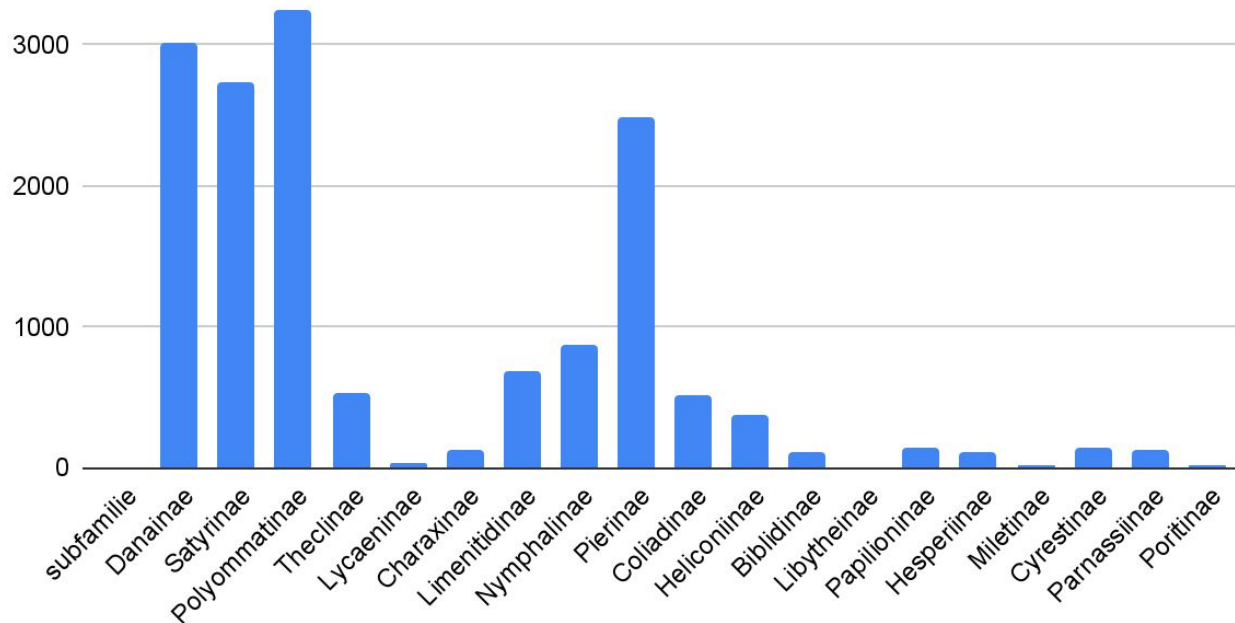
Soortetermodel

- Gebaseerd op tekst op etiketten
- Sorteren van ongedetermineerde collectie op **families**, subfamilies en genera



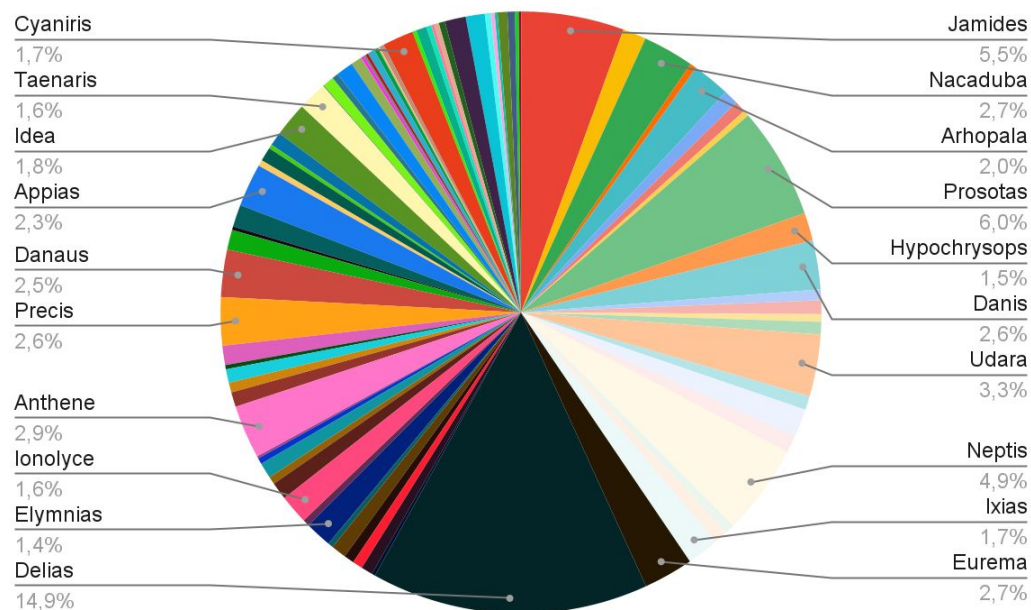
Soortetermodel

- Gebaseerd op tekst op etiketten
- Sorteren van ongedetermineerde collectie op families, **subfamilies** en genera



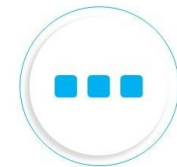
Soortetermodel

- Gebaseerd op tekst op etiketten
- Sorteren van ongedetermineerde collectie op families, subfamilies en **genera**



Planning beeldherkenning

- Modellen trainen voor alle dagvlinderfamilies: **voltooid**
- Modellen testen, hertrainen en verfijnen: **doorlopend**
- Beeldherkenning implementeren in werkproces: **2022 - 2025**



**Bedankt voor
jullie aandacht!**



Colofon:

Afbeeldingen collectie en medewerkers Naturalis: CC-0

Afbeeldingen Van Groenendael: uit A.J. de Boer (1998), coll. Zoölogisch Museum